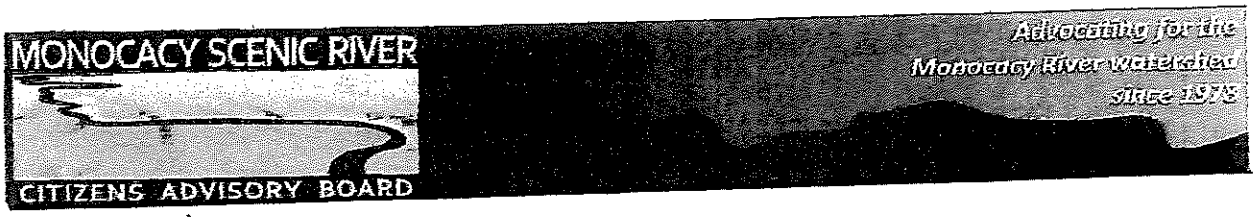


To: Carroll County Board of County Commissioners, Frederick County Council, and Frederick County Executive

Re: The revised Monocacy River Management Plan Update as finalized 10/3/18 is attached for your consideration and adoption.

Date: November 8, 2018

Dear Frederick County Council members, the Carroll County Board of Commissioners, and Frederick County Executive:

On October 3, 2018, the joint-county Monocacy Scenic River Citizens' Advisory Board completed and approved its update of the August 2, 2017 Monocacy Scenic River Management Plan (which represents an update to the longstanding 1990 Monocacy River Plan). The vote to approve the 10/3/18 River Plan update was unanimous by all River Board members present on October 3, 2018.

The River Board authorized me to re-send a transmittal letter to you, with the 10/3/18 finalized River Plan enclosed for review and approval.

Most importantly, the 10/13/18 River Plan is consistent with the desires of both counties to successfully reform the previously submitted 8/2/17 River Plan Update which was rejected by the Carroll County Commissioners; The Frederick County Council; and the Frederick County Planning Commission. The attached 10/3/18 finalized River Plan incorporated most every suggested revision provided by the above parties to address remaining concerns.

The River Board firmly believes this 10/3/18 River Plan update is a collaborative and successful joint county plan that should satisfy all constituents.

In general, the concerns from both counties and the public focused on: strengthening the property rights language; clarifying the voluntary nature of the Plan's initiatives and and removing and clarifying ambiguities and redundancies in the Plan. It seems the overall desire from so many factions was to have a single, unified, joint-county River Plan update that protected both The Monocacy and citizens' property rights.

This has been achieved.

While the River Board addressed the above concerns to update the Plan, in no way will the revisions lessen any of the numerous efforts already in place to protect the Monocacy Scenic River – with many protective measures highlighted in Chapters 6 and 9 of the River Plan. Information in these chapters discuss the layers of federal, state, and local regulations and conservation programs that have been successfully helping to improve the water quality and environment of the Monocacy Scenic River as evidenced by improved and cleaner water in The Monocacy and to The Chesapeake Bay (which has achieved the cleanest water in decades).

There is nothing in the 10/3/18 that hurts The Monocacy River, only suggestions that benefit the river and watershed.

The counties provided a combined total of 40 suggested reforms to the River Board (including recommendations to revise the plan from the Planning Commission which the board reviewed). As a result, the Board made just over 40 revisions to the finalized 10/3/18 River Plan to address the suggested reforms and remaining concerns.

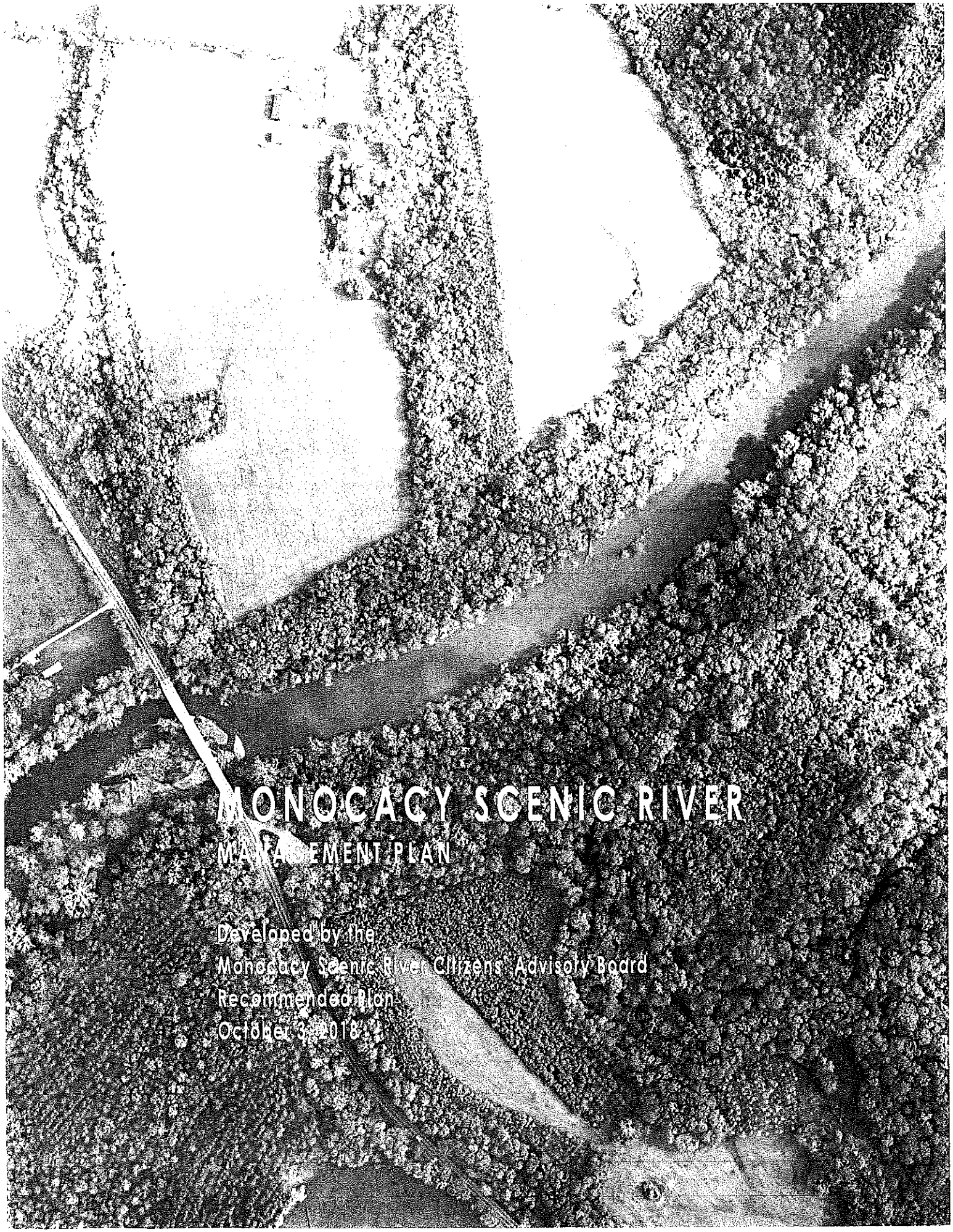
Additionally, The River Board also received and heard extensive public comments from citizens of both counties for two (2) years during board meetings and numerous public hearings. The 10/3/18 River Plan update, based on joint-county and citizen input - only helped produce a more reasonable and successful River Plan to address remaining concerns, without doing anything to negatively affect the Monocacy Scenic River.

It is truly a joint-county successful plan ready for adoption.

Respectfully,

Earl S. Bell

Colonel USAF (ret) / Vice Chairman Monocacy River Board



MONOCACY SCENIC RIVER

MANAGEMENT PLAN

Developed by the
Monocacy Scenic River Citizens' Advisory Board
Recommended Plan
October 3, 2018

Cover Image: MD-28 Bridge over the Monocacy at the Monocacy Natural Resource Management Area

The Monocacy Scenic River Management Plan 2018

Dedication, experience, and a respect and concern for the Scenic Monocacy River, its riparian habitat, water quality, and its watershed describe the overall efforts of the Monocacy Scenic River Board. They spent many hours in the creation and review of the update to the 1990 Study and Management Plan, deliberating issues and making final recommendations. The River Board also extends its gratitude and thanks to those people who previously served on the Board, and to all who appreciate, admire, and utilize the Monocacy River. It's the River Board's hope that the 2018 Monocacy River Management Plan will ensure that future generations will encounter a healthy, vibrant, resilient Monocacy River and will enjoy and protect the River.

Monocacy Scenic River Citizens Advisory Board

Carroll County
Patricia Baumgardner
George Grillon, DMD
Vincent Baginsky
Rhonda Bean
Earl Bell, R.A., LEED AP, MBA, Colonel USAF (ret.)
Byron Madigan, Carroll County Bureau of Resource Management (staff)

Frederick County
Bob Whiting
Stan Mordensky
Matthew Toms
Jack Lynch
Sam Roop
Pam Reppert (ex-officio, City of Frederick)
Tim Goodfellow, AICP, Frederick County Division of Planning and Permitting (staff)

In addition to the Staff and the River Board members, there were many people who have contributed directly or indirectly to this document.

John Mullican, Maryland Department of Natural Resources Inland Fisheries

Anne Bradley, Frederick County Land Preservation

Mike Wilkins, Frederick County Planning Department

Denis Superczynski, Frederick County Planning Department

Dial Keju, Frederick County Planning Department

Darlene Bucciero, Frederick County Office of Sustainability and Environmental Resources

Curtis Dalpra, Interstate Commission on the Potomac River Basin

Adam McClain, Adams County Conservation District

Lynda Eisenberg, Carroll County Planning Department

David Curson, PhD, Audubon Maryland/DC

Lynn Davidson, Maryland Department of Natural Resources Wildlife and Heritage Service

Benjamin Marshall, Natural Resources Conservation Service, Frederick, Maryland

Chelsea Jeffries, Adams County Office of Planning and Development

Mike Kay, Maryland Department of Natural Resources Forest Service

David Verdone, Natural Resources Conservation Service, Frederick, Maryland

Kate McDermott, professional writer and editor

Michael Kashiwagi, Maryland Department of Natural Resources

Deborah Bowers, Carroll County Department of Land and Resource Management

Rick Slade, National Park Service, Monocacy National Battlefield

Andrew Banasik, National Park Service, Monocacy National Battlefield

Daniel Carter, National Park Service, Monocacy National Battlefield

Louisa McIver, Chesapeake Conservation Corps

Angelia Miller, Cheseapeake Conservation Corps

Mark Spencer, former Maryland Department of Natural Resources, planner who helped develop the 1990 River Management Plan with the River Board

The update of the 1990 Plan would not have been possible without the professional and invaluable efforts of the following people:
Special thanks to
John Dimitriou, R.A., Frederick County Planning Department, for helping with the design and layout
Ethan Blair, Frederick County Information Technologies, who created all the maps contained in the Plan
Kevin Szatmary, Frederick County Information Technologies, for editing the final draft

Frederick County
Jan H. Gardner, County Executive

Frederick County Council
Bud Otis, President
M.C. Keegan-Ayer, Vice President
Treasurer Tony Chmelik
Jessica Fitzwater
Jerry Donald
Kirby Delauter
Billy Shreve

Carroll County Board of Commissioners
Stephen Wantz, President
Richard Weaver, Vice-President
Dennis Frazier, Secretary
Richard Rothschild
Doug Howard

Executive Summary

The Monocacy River, one of Maryland's nine Scenic and Wild Rivers, is noted for the rich and diverse bounty of its waters and beautiful scenery along its shoreline. As one of Maryland's greatest treasures, the River provides public drinking water, wildlife habitat, aesthetic beauty, and instills community pride. Yet, nearly three centuries of development have dramatically changed the natural and cultural resources of the River. The challenge of protecting this valuable resource is difficult in a watershed that continues to experience change and population growth. Stewardship and responsible care of any asset — including a State-designated Scenic River — require targeted action and decisions to ensure long-term health, function, and protection.

This Plan revises the 1990 Monocacy Scenic River Study and Management Plan. It describes the River's multiple features, unique environmental resources, its natural and cultural history, and linkages to land and the surrounding community. The Plan is not a mandate but contains suggested recommendations for consideration, like other county and municipal plans, in guiding government actions and land use decisions for the protection of the River. The goal of the suggested recommendations is not to stop development, impede agriculture and other initiatives, or to infringe on landowners' property rights, but to advocate for sustainable land uses, best management practices, and activities that respect and protect the River and its watershed.

The recommendations in the Plan are included at the end of chapters 4 through 9. Some of the suggested recommendations for action and implementation are directed at the Monocacy Scenic River Citizens' Advisory Board, the official Frederick and Carroll County advocate for the River. All other recommendations are offered specifically for consideration by Frederick and Carroll Counties, the City of Frederick, and the Town of Walkersville, Maryland.

Cooperative efforts are critically important to the well-being of the Monocacy Scenic River. Frederick and Carroll Counties, the City of Frederick, the Town of Walkersville, and other watershed jurisdictions are encouraged to implement programs of best practices and cooperate with and among all parties (landowners and farmers along the River, residents, civic groups) to further preserve and enhance the valuable resources—described in this Plan—of the Monocacy Scenic River. The River Board recognizes the public right-of-way on the waters of the Monocacy River, and the fact that the banks of the River, for the most part, are private land, and the rights of private property owners need to be protected. The Monocacy River Management Plan promotes, through a variety of community partnerships, public actions, and private initiatives, the following practices along the River: voluntary reforestation, voluntary environmental restoration, voluntary wetland enhancement, voluntary wildlife habitat improvements, and additional funding for River land preservation. The River Board believes collaboration to be a 'win-win' for residents, local governments, and the Monocacy Scenic River.

Additionally, any future legislation or regulation based on the plan should support the rights of property owners. This plan does not advocate public use of private property, the compromise of Constitutional property rights, or recommend zoning changes.

Key recommendations for consideration include, but are not limited to, the following:

- Voluntary environmental improvements to the River's riparian areas
- Voluntary reforestation of critical gaps for wildlife habitat, bank stability, and flood attenuation
- Promotion of additional River access and recreation on public lands (This plan does not support use of eminent domain or regulatory measures on private property)
- Increased public awareness about the River through public relations and educational programs, and private property rights
- Enhanced stewardship of all land uses in the River for water quality protection, mandatory federal and state nutrient and sediment load reductions, and continued agricultural viability and economic contributions
- Conduct a comprehensive study of water quality in the entire Monocacy River watershed, including Maryland and Pennsylvania, be taken and no regulatory action be taken until such study is completed

During its preparation, this Plan was provided to the governments of Frederick and Carroll Counties, the City of Frederick, and the Town of Walkersville for review and comment. Six (6) public comment sessions were held by the River Board to give opportunity for all interested people and groups to comment on the Plan. Verbal and written comments were considered and assessed as part of the due diligence employed by the River Board in the develop of its final, approved Plan.

The recommendations contained in this Plan should be tracked and the Plan should be reviewed by the River Board for update, as appropriate, at least every ten years.

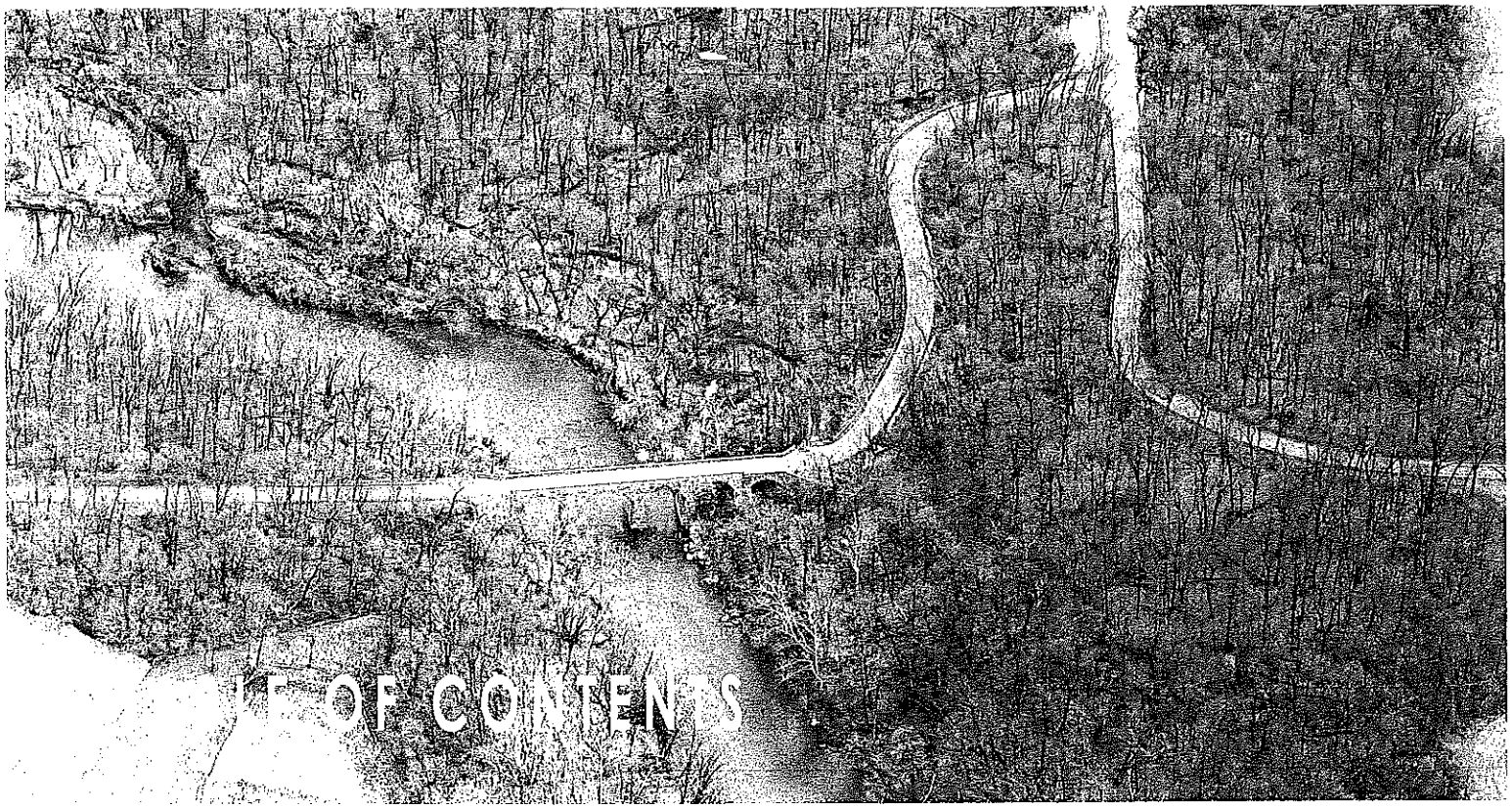
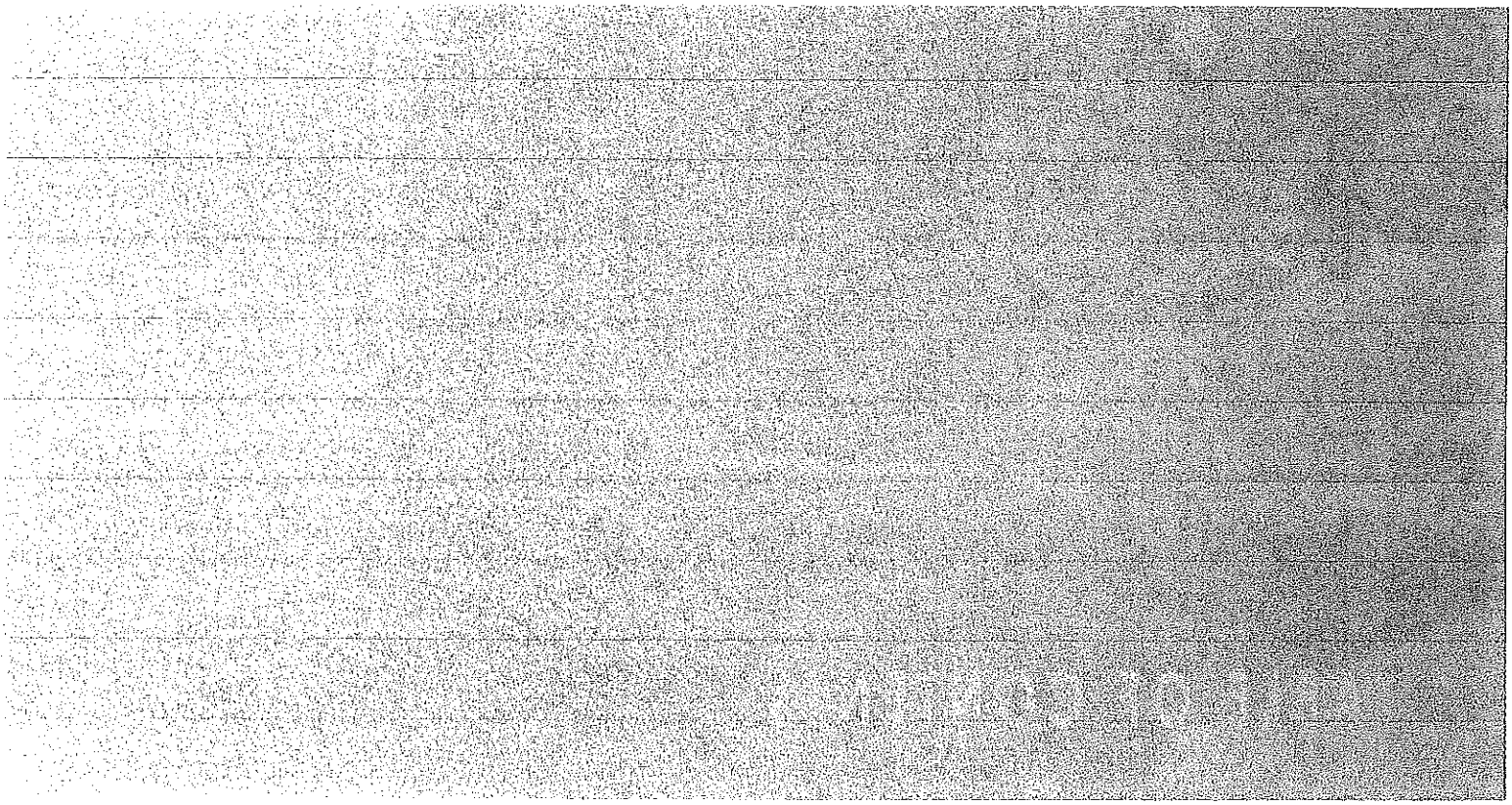


TABLE OF CONTENTS

Aerial View of LeGore Bridge

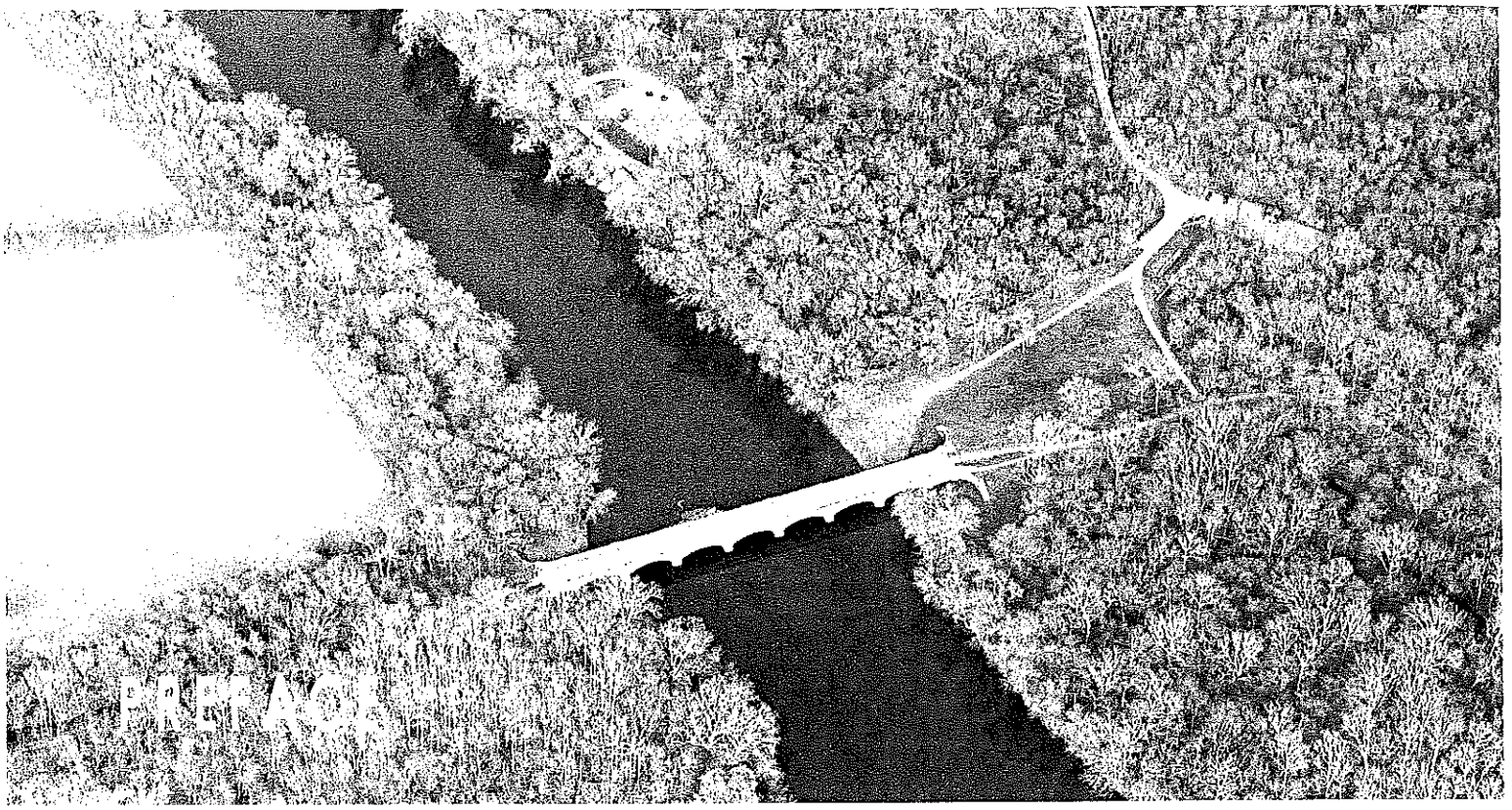


The best time to plant a tree was 20 years ago;
the second best time is now.

Chinese proverb

GOALS OF THE MONOCACY SCENIC RIVER MANAGEMENT PLAN

- Advocate for sustainable land uses, best management practices, and activities that respect the river while respecting property rights of landowners along the river.
- Maintain and improve the ecological health and productivity of the Monocacy River
- Improve the River's water quality
- Promote land use compatibility and attention to environmentally sensitive areas to maximize conservation and sound use of the Monocacy's riparian resources
- Identify incentives and cooperative approaches for stewardship of significant scenic and ecological areas, historic and archaeological sites, and other valued River-related resources
- Provide resource information about the Monocacy River for local, state, and federal governments, elected officials, civic groups, environmental organizations, and the residents of Carroll and Frederick counties
- Develop multi-jurisdictional cooperation and coordination for the management and protection of the Monocacy River
- Increase public awareness about important Monocacy River resource values through outreach and environmental education
- Pursue the vision for the Monocacy River, articulated by Maryland's Wild & Scenic River Act
- Implementation of the Plan's recommendations should not stop development or impede agricultural activities and other initiatives

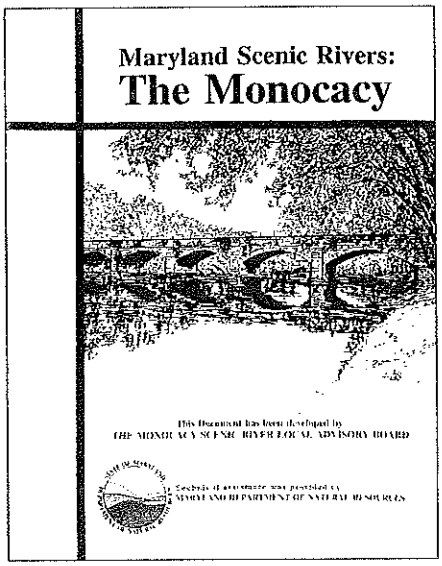


Monocacy Aqueduct in the C&O Canal National Park

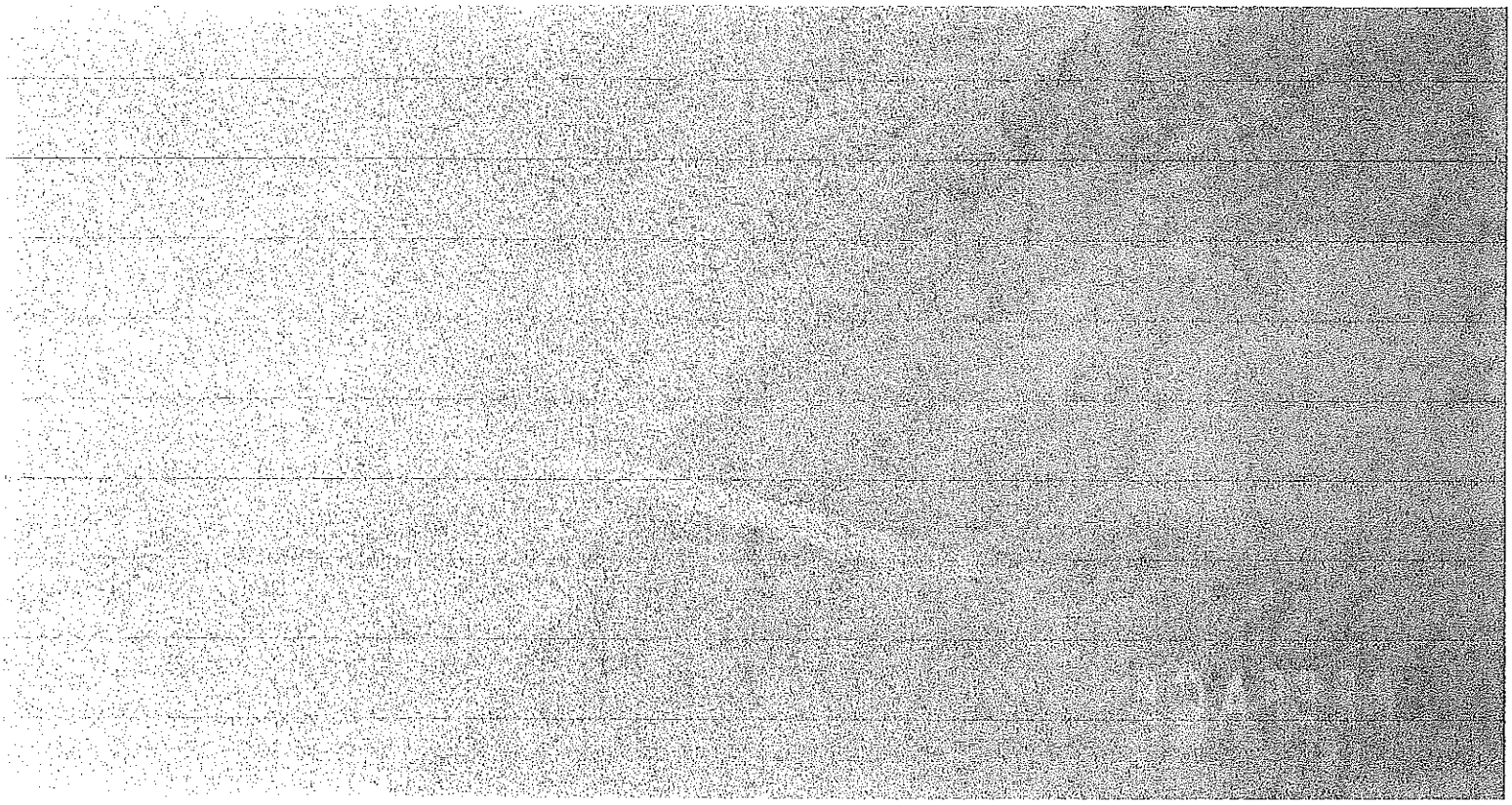
The Monocacy River and its tributaries are a valuable and rich resource that provide water for domestic consumption, fish and wildlife habitat, effluent disposal, recreation, and many other uses. The Monocacy River Management Plan is a coordinated effort that directly addresses riverine resources and related issues and makes recommendations for the protection and conservation of those resources.

The 1968 Maryland Scenic and Wild Rivers Act called for the protection of Maryland's river resources through an organized program of inventories and land use planning. The Maryland Department of Natural Resources and the Monocacy Scenic River Citizens' Advisory Board (River Board) created the initial *Monocacy River Study and Management Plan* in 1990, which was approved by both the Carroll County and Frederick County Boards of Commissioners, and by the Maryland General Assembly in 1991 through House Bill 1123.

The *1990 Plan* has been used, to varying degrees, for input or for providing guidance on a variety of federal, state, and local programs, policies, and regulations, and on public and private projects. In 2015, the River Board, Frederick County, and Carroll County initiated a revision to the *1990 Plan*, to reflect current knowledge, status, and condition of the ecological, social, and political environment related to the Monocacy River. "The study and plan will require future revisions to address newly evolving conservation issues," is a statement from the Preface in the *1990 Plan* that is now being realized. The River Board enlisted the support and engagement of various governmental partners, professional acquaintances and others in the revision to the *1990 Plan*.

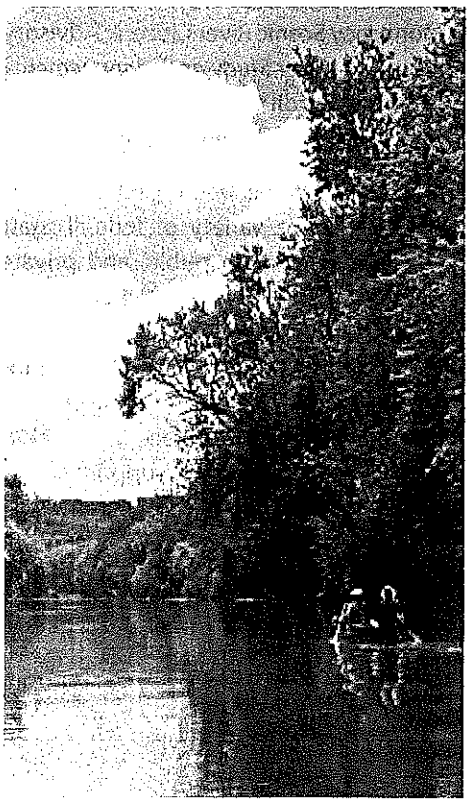


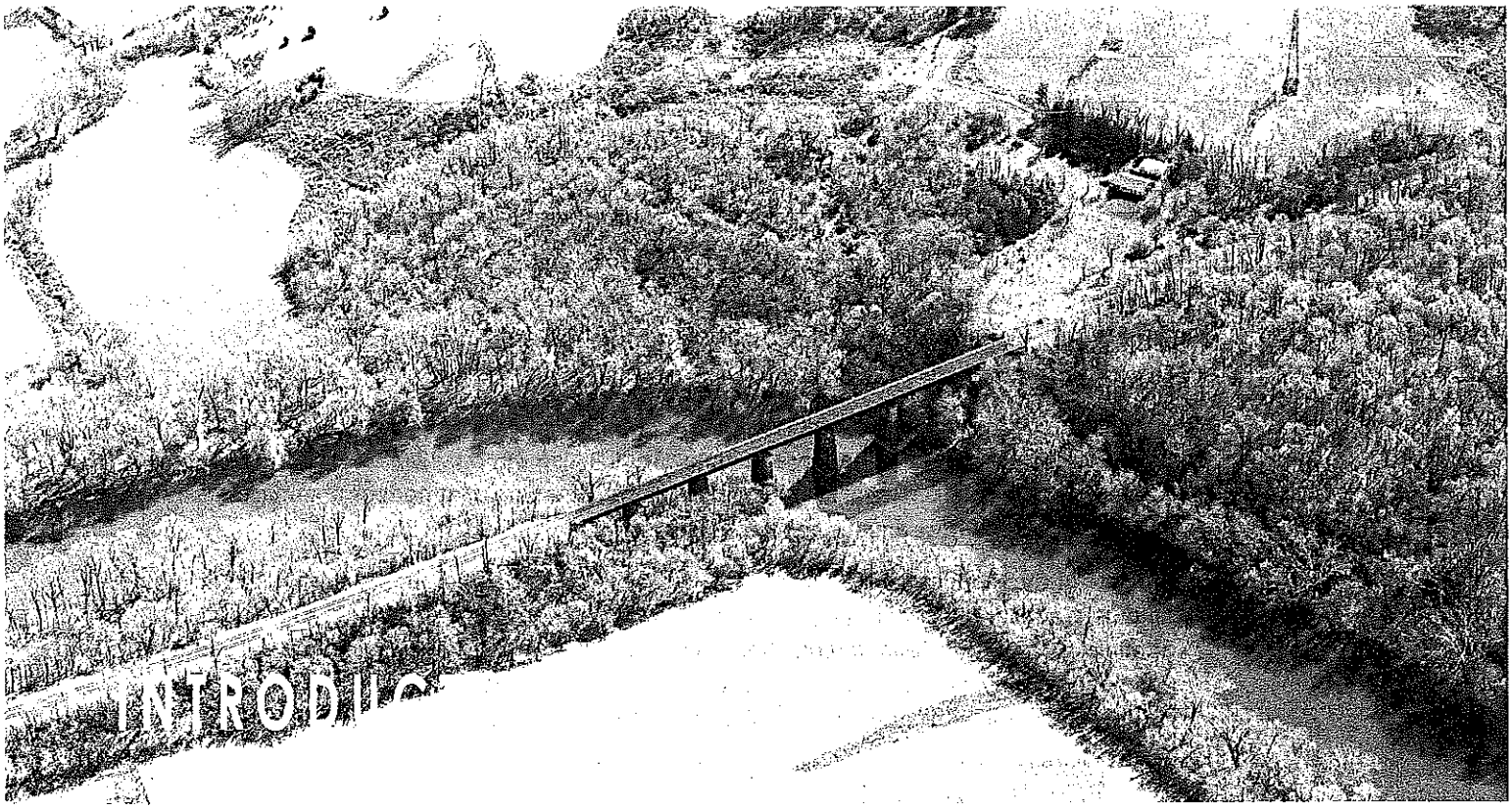
1990 Plan



[illegible] the rippling of rivers
[illegible] deepair of anything.

Henry David Thoreau





Railroad bridge north of the Monocacy Aqueduct

Beginning in headwater streams in Adams County, Pennsylvania and flowing over fifty miles through central Maryland, adjoining Carroll County, Maryland and cutting though Frederick County, Maryland, the Monocacy River is the largest Maryland tributary of the Potomac River. The Monocacy River has sustained human populations for nearly ten thousand years, from tundra mammoth hunters to Native American woodland villages along its shores, to our growing modern communities.

In the 1970's, great public effort arose to protect the Monocacy from a government-proposed water supply system for the Washington region (further detail in chapter 6). The Monocacy was to be dammed at Sixes Bridge Road in Frederick County. A "Save the Monocacy" campaign was started and subsequent efforts to enact a Maryland Scenic River regulation, advisory boards, and programs and protection plans for those rivers began. The Monocacy Scenic River Citizens' Advisory Board was created, and the current Plan is the result of its efforts to renew preservation and protection efforts and to educate and inform the communities it serves.

The Monocacy River Watershed is a 970-square-mile-basin, which drains into the Potomac River approximately 20 miles above Washington, DC. At its beginnings on the Mason-Dixon Line, the Monocacy River is approximately 70 feet wide. By the end of its journey to the confluence with the Potomac River, the width of the Monocacy has increased to 300 feet. The River's gradient is gentle, averaging three feet per mile with only minor variance. There is but one set of natural rapids on the Monocacy — Greenfield Rapids — a river-wide, 3-stage ledge approximately four miles above the mouth, which in total drops 2-3 feet in elevation. A second rapid, at Michaels Mill near Buckeystown, is man-made and has been created by a breach in the remains of a dam that served the mill during its period of operation.

Additionally, there are two existing dams on the river. The first is the four foot high Starners Dam, located two miles downstream from the river's source and immediately above the Shoemaker Road bridge crossing. The second is a three foot dam adjacent to the Forest and Stream Club, less than a mile upstream from the Route 77 bridge crossing between Rocky Ridge and Detour.

The Monocacy, as a scenic river, has provided many recreational opportunities and a home to a variety of wildlife and fish. Along much of its course, the river appears as it did when Native Americans

walked its banks, albeit with several prominent and noticeable impacts by land development with reduced canopy cover that detracts from its scenic qualities.

In recent years its use as a drinking water supply has declined, and its treated effluent has improved greatly with Enhanced Nutrient Removal systems throughout the watershed and consolidation of sewerage systems.

However, historic stormwater practices and land uses have taken a toll, resulting in watershed-wide federal and state mandated input reductions (Total Maximum Daily Loads/TMDLs) for sediment, nutrients, and bacteria. The array of chemicals introduced include modern pharmaceuticals and other substances whose aquatic impacts are not fully known.

The fate of the Monocacy River, as for the Chesapeake Bay, lies upon the balance between sound land uses, agriculture and development, and human activity practices, down to the individual. The administration of policies and regulations governing these issues have increased greatly in recent years and is costly, but necessary in order to achieve water quality of the past, a resilient river, and a healthy and sustainable future for the Monocacy River and our communities.

Left: The River just north of Michaels Mill

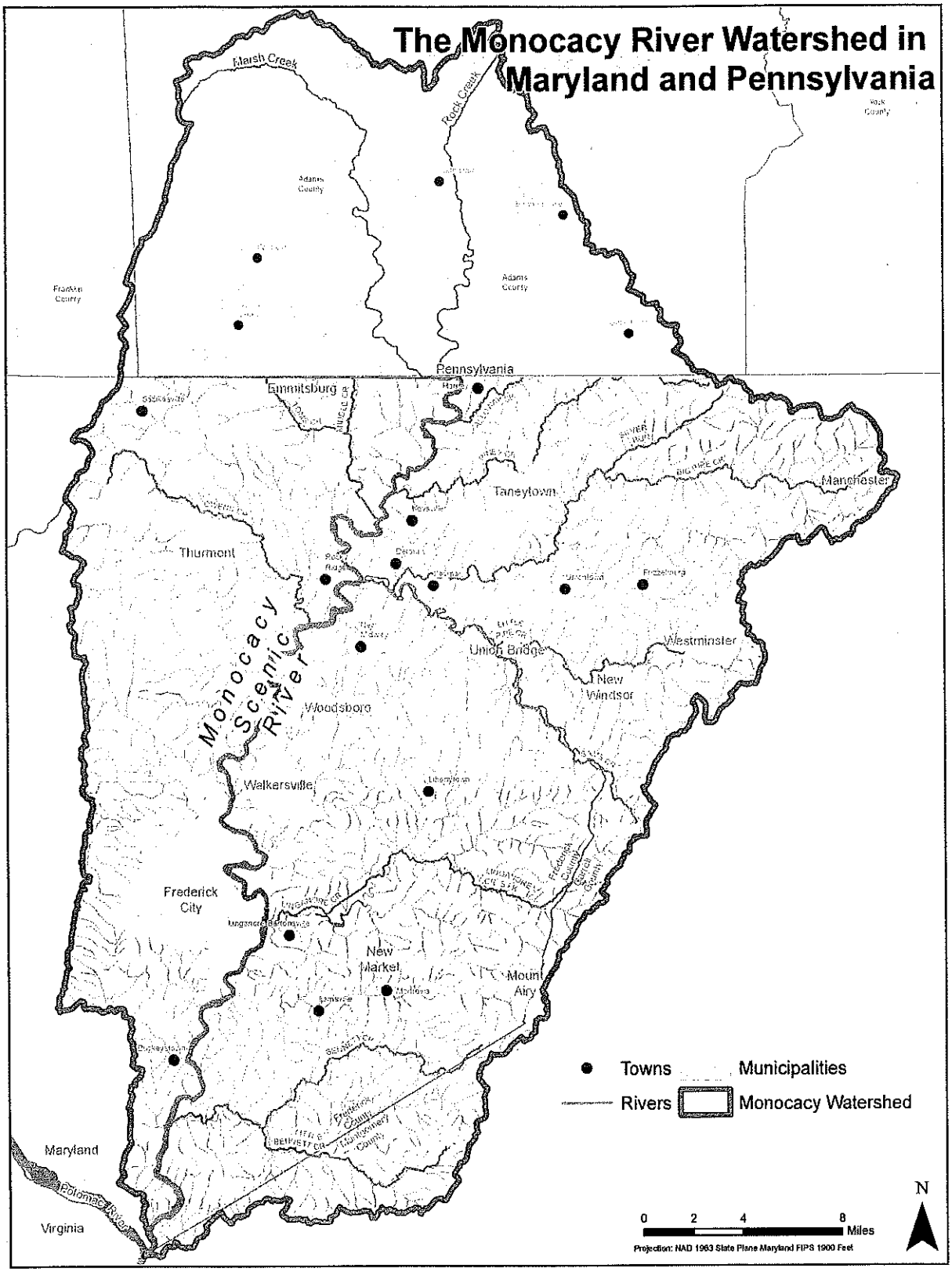
Right: Near Creagerstown

Scenic Rivers Planning History

The first organized attempt to restore the Monocacy resulted in the creation of the Interstate Monocacy Watershed Council in 1949. After studying the problems of the watershed, the Maryland State Planning Commission released Publication Number 70: *A Program for the Monocacy Watershed,* in 1951 (1). The report recognized that some federal and state conservation efforts were underway to restore the watershed's resources, but these efforts were not coordinated and were usually inadequately funded. The report's major recommendations were to dramatically increase soil and water conservation efforts and to reforest extensive areas of the watershed. Water quality needed to be improved, local wildlife habitat needed restoration, and recreational resources required careful development. This simple message, although 60 years old, is as true today as it was then.

After the Maryland Scenic and Wild Rivers Act of 1968 was adopted, the first inventory, Scenic Rivers in Maryland, was released by the Maryland Department of State Planning in 1970 (2). The Monocacy River was identified as a significant state resource, worthy of immediate study, and as a prime candidate for State Scenic River designation. On April 30, 1974, the Monocacy River was added to the Maryland Scenic River System.

The scenic river planning process was initiated in 1976 when the Frederick and Carroll County


The Monocacy River Watershed in Maryland and Pennsylvania
Marsh Creek
Rock Creek
Adams County
Franklin County
Adams County
Pennsylvania
Emmitsburg
Taneytown
Manchester
Thurmont
Monocacy Scenic River
Union Bridge
Westminster
New Windsor
Woodsboro
Walkersville
Frederick City
New Market
Mount Airy
Maryland
Virginia
Potomac River
Towns
Municipalities
Rivers
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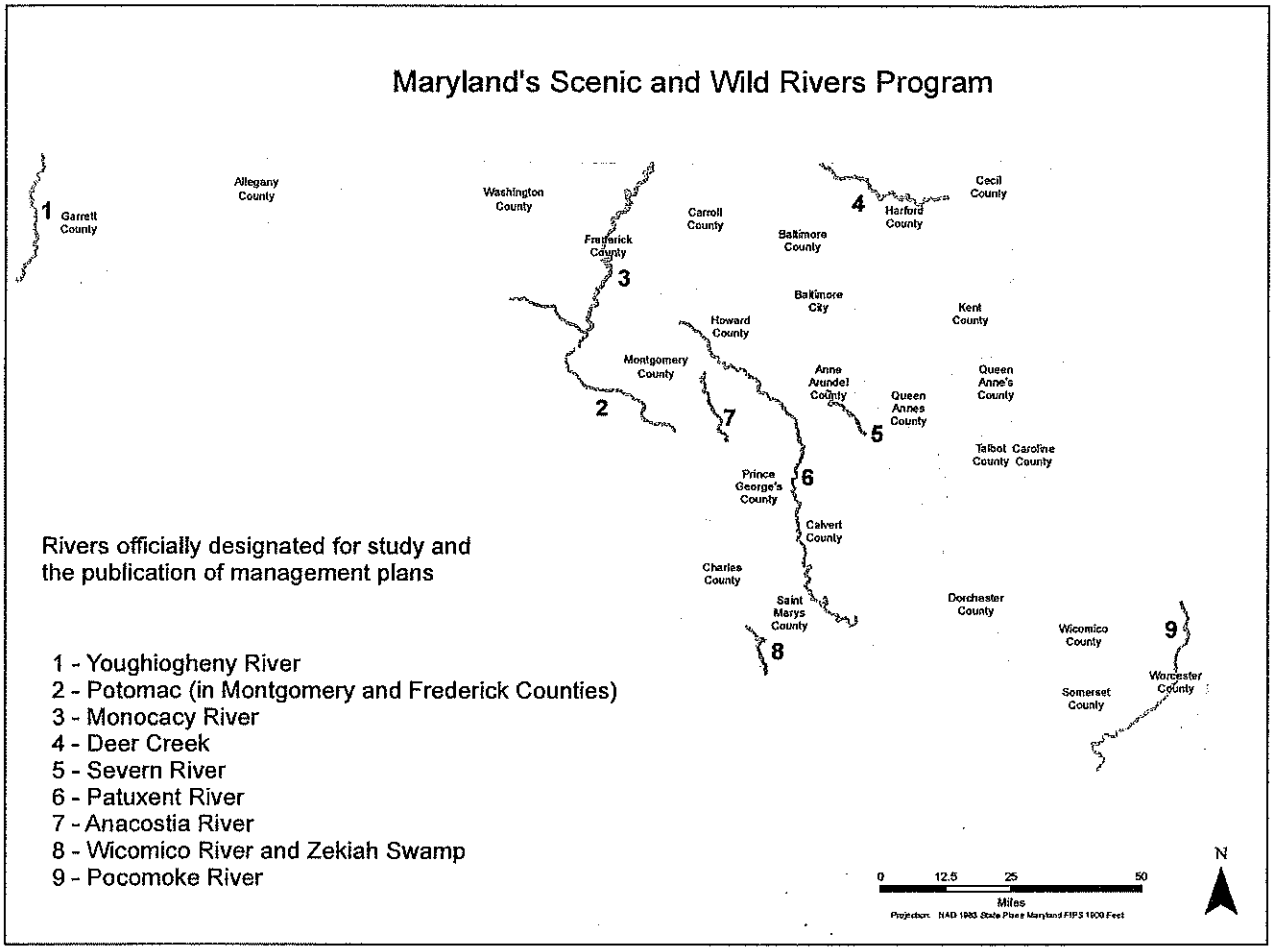


Commissioners were contacted to assist with the organization of the Monocacy Scenic River Citizens Advisory Board. The River Board met for the first time in 1978 and participated in a recreational use study conducted by the University of Maryland.

In 1982, the National Park Service published The National Rivers Inventory which identified American rivers that were eligible for National Scenic River designation. Fifty-two miles of the Monocacy from Bridgeport to the Potomac, were identified as eligible for National Scenic River designation. The river was described as possessing significant natural and recreational resources as well as outstanding Native American archaeological resources (3).

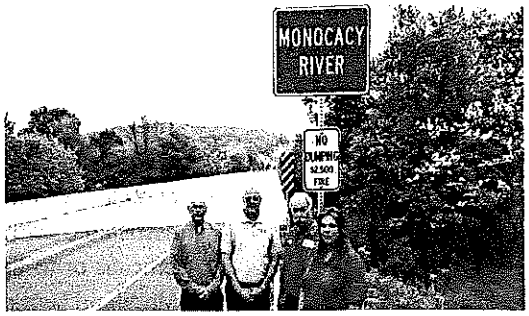
Monocacy Scenic River Board

The Monocacy Scenic River Board is comprised of ten members, five appointed by the Carroll County Commissioners and five appointed by the Frederick County Executive. The River Board's membership includes an ex-officio member from the City of Frederick, and a member from the Frederick County Farm Bureau. Staff support to the River Board is provided by both county governments.

The Board reviews and makes recommendations on federal, state, and local programs, policies, and regulations, plus public and private projects, including land use and development proposals.

They serve as advocates for the River and its varied resources. Over the years, the River Board has been actively involved in many wide ranging and varied issues that could impact the River. Both county governments support the River Board and, as one of many volunteer bodies in both counties, it provides an opportunity for residents to become engaged stewards of the Monocacy River. Annual reports of the River Board's many actions and accomplishments can be found at the following:

http://www.frederickcountymd.gov/194/Monocacy-Scenic-River-Citizens-Board
http://ccgovernment.carr.org/ccg/lrm/msr/



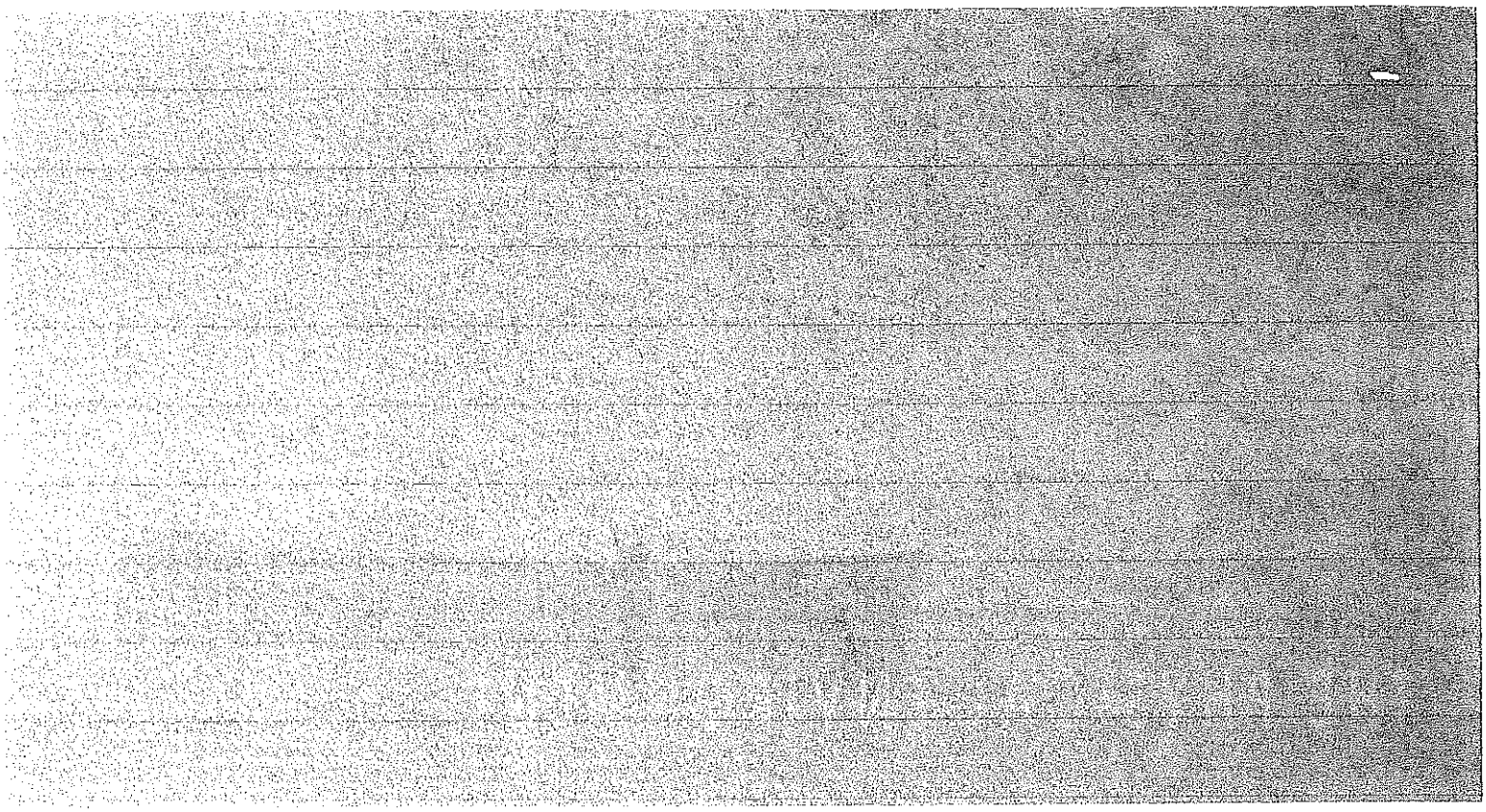
Former Frederick County Commissioner David Gray, plus staff from Frederick County Department of Highways & Facilities Maintenance at Links Bridge Road, under one of the signs installed on all Monocacy River bridges.

For six consecutive years, the River Board hosted and participated in a public clean-up event along the Monocacy River in Rivermist Park (Monocacy Boulevard in Frederick), as part of the Alice Ferguson Foundation's Potomac River Watershed dedicated clean-up day. The annual Potomac River Watershed clean-up event has been ongoing for over two decades and is designed to not just remove rubbish from the shared environment, but to raise awareness of trash generation and disposal issues. The River Board looks forward to continued participation in this public engagement and River beautification project, and other collaborative actions with local governments, River-front

There have been two events recently that highlight an environmental issue and the actions taken by the River Board to address it. In 2013, with the assistance of Junior Fire Company No. 2 in Frederick, the River Board hauled nearly 70 tires and other debris from a one mile stretch of the River near Monocacy Boulevard. Again in 2014, the River Board targeted another one mile section of the River near Woodsboro and removed close to 100 tires from the River's banks and channel. This gives a perspective on the magnitude of the tire dumping problem in the River and lack of care or awareness of the river resource.

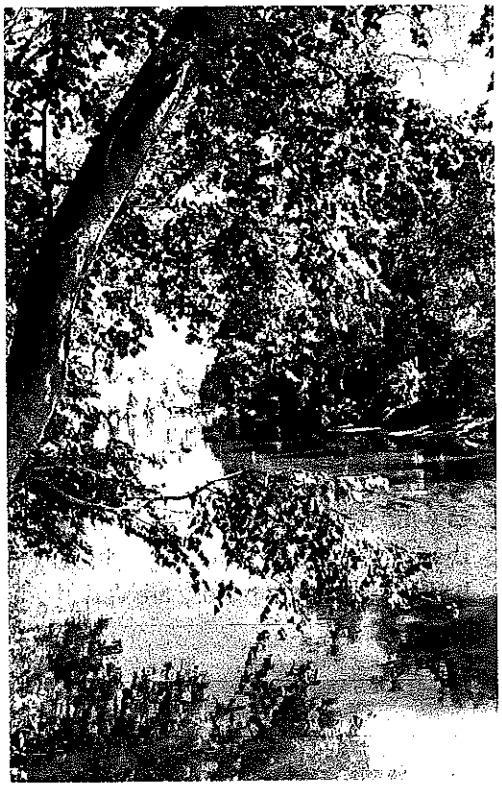
landowners, and citizens to achieve enhancement and protection goals for a healthier River for our residents, communities, and environment.

The River Board was successful in having Frederick County and Carroll County install River identification signs at bridges crossing the Monocacy River that also include the penalties associated with illegal dumping. Residents are strongly encouraged to report illegal activity associated with the Monocacy River to the appropriate county or municipal law enforcement officials or to the Maryland Department of Natural Resources Police, the enforcement arm of the Maryland Department of Natural Resources. For dead or dying fish in the Monocacy River, contact the Maryland Environmental Hotline at 877-224-7229 or the Maryland Department of Natural Resources' Freshwater Fisheries Program at 301-898-5443. For hazardous spills in the Monocacy River, contact the following entities: Interstate Commission on the Potomac River Basin (ICPRB) at 301-274-8133; the Maryland Department of the Environment at 866-633-4686; the U.S. EPA at 800-424-8802.



... question of rivers,
... of the human heart.

Tanaka Shozo



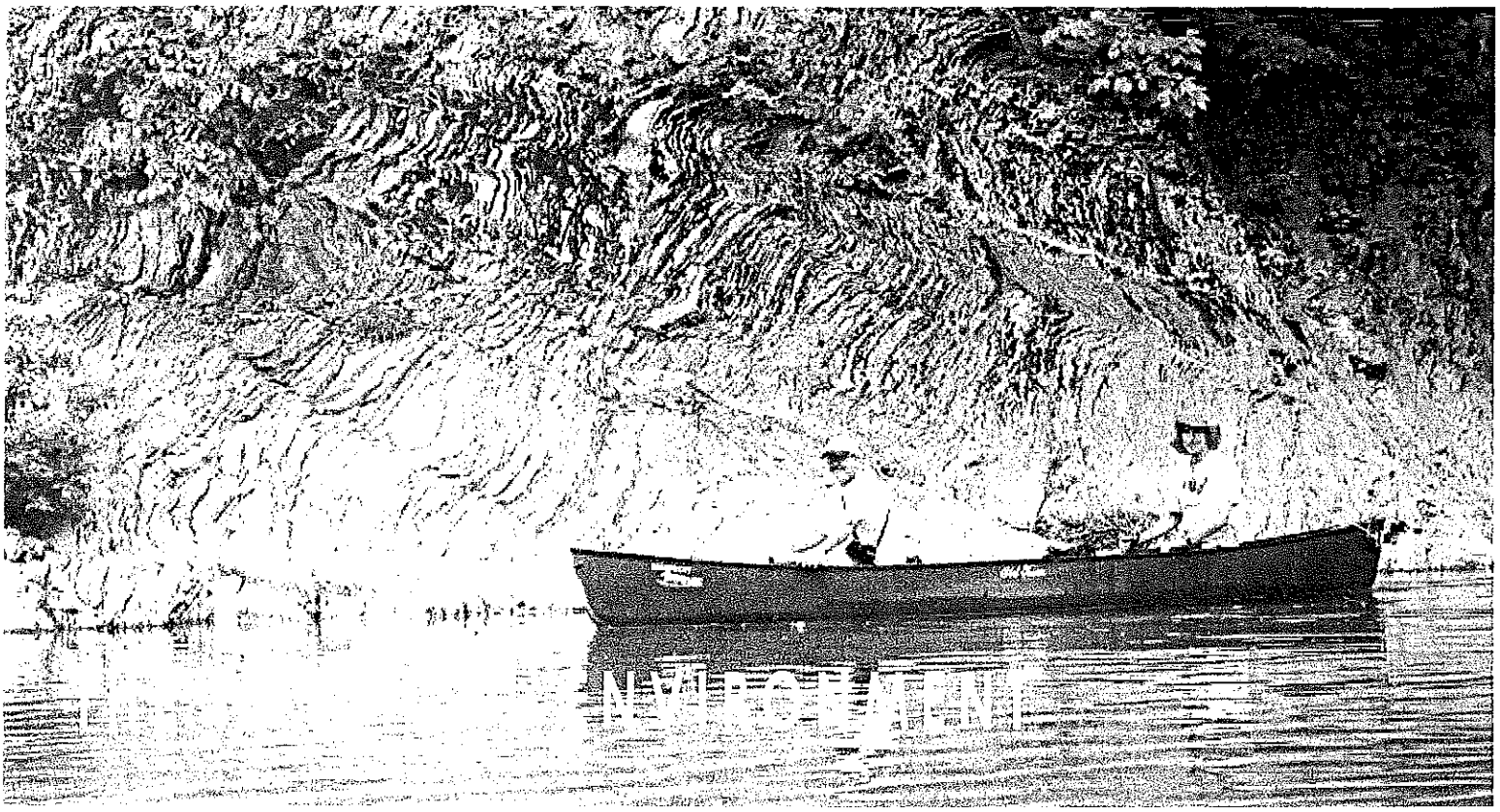


Photo by Kai Hagen

Geography and Topography

The Monocacy River flows through central Maryland's Frederick and Carroll Counties. The river is located on the western edge of the Piedmont Physiographics Province, adjacent to the mountainous Blue Ridge Province. Beginning at the confluence of Marsh and Rock Creeks near the Pennsylvania and Maryland border, the Monocacy slowly meanders 58.2 miles in a southerly direction to the Potomac River. The watershed represents approximately 970 square miles of the 14,640 square mile Potomac River basin. Fifteen percent of the Monocacy River basin lies in the Blue Ridge Province; the remainder is in the Piedmont Province.

Topography is an expression of the relative positions and elevations of land regions. The Frederick Valley, through which the Monocacy flows, is nestled between the Catoctin Mountains to the west, and the lower Parrs Ridge to the east. A relatively flat plain extends west from the river to the Catoctin Mountains, where the basin reaches a height of up to 1,600 feet. The river valley's topography includes little steep terrain, but some steep gradients do exist adjacent to the river. These land elevations and the degree of slope have influenced land use in the watershed. The region's relatively flat topography has made it easily accessible for development and agriculture in some areas next to the river and its tributaries.

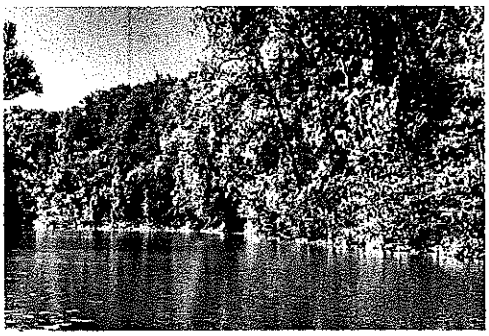
Geological History

The topography and other physical characteristics of the Monocacy River basin were created through a variety of geomorphic actions including geological upheavals, and the combined erosive forces of wind, water, temperature fluctuations, and gravity. The Monocacy River watershed is located in the Piedmont and Blue Ridge Physiographic Provinces. The rock formations that influence the river basin's geological history are varied and include both intensely metamorphosed and sedimentary rock types.

The Piedmont Province within the Monocacy River Watershed is further divided into the following major sections, as shown on the accompanying map:

1) Piedmont Lowlands – Includes the Frederick Valley north to Woodsboro. This section is a carbonate valley of low relief with gentle rolling topography, deep soils, and streams with shallow banks. The predominate underlying rock type here is Frederick and Grove limestones. The northern and western areas of the Piedmont Lowlands are called the Mesozoic Lowlands Region and extend from the Catoctin Mountains to east of Taneytown. This area is characterized by more rolling topography with shallower red soils and underlain by red shale, siltstone, and sandstone bordered with quartz conglomerate.

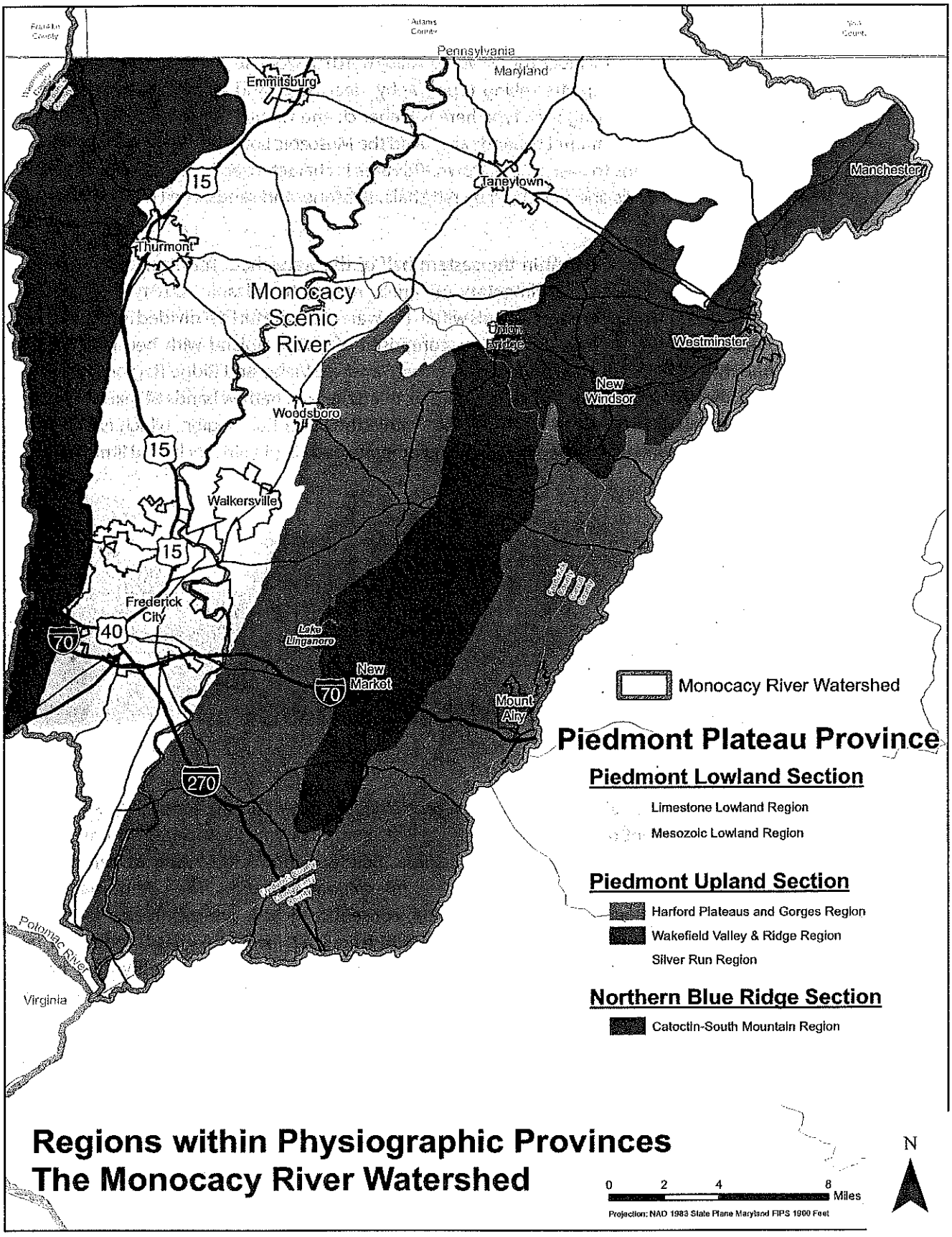
2) Piedmont Uplands – Present in the eastern half of the watershed. This section is underlain by metamorphic, igneous, and sedimentary materials, related to volcanic activity that occurred in Precambrian time. The Piedmont Uplands within the watershed are further divided into three regions. The Harford Plateaus and Gorges Region, comprised of rolling upland with herringbone texture and underlain with siltstones and quartzites; the Wakefield Valley and Ridge Region, comprised of polydeformed metrahyolite, phyllite, metabasalt, quartzite, and narrow bands of marble; and finally, the far northeast corner of the watershed lies within the Silver Run Region, which is comprised of rolling upland underlain by quartzite and conglomerate beds in phyllitic rocks and limestone bands.



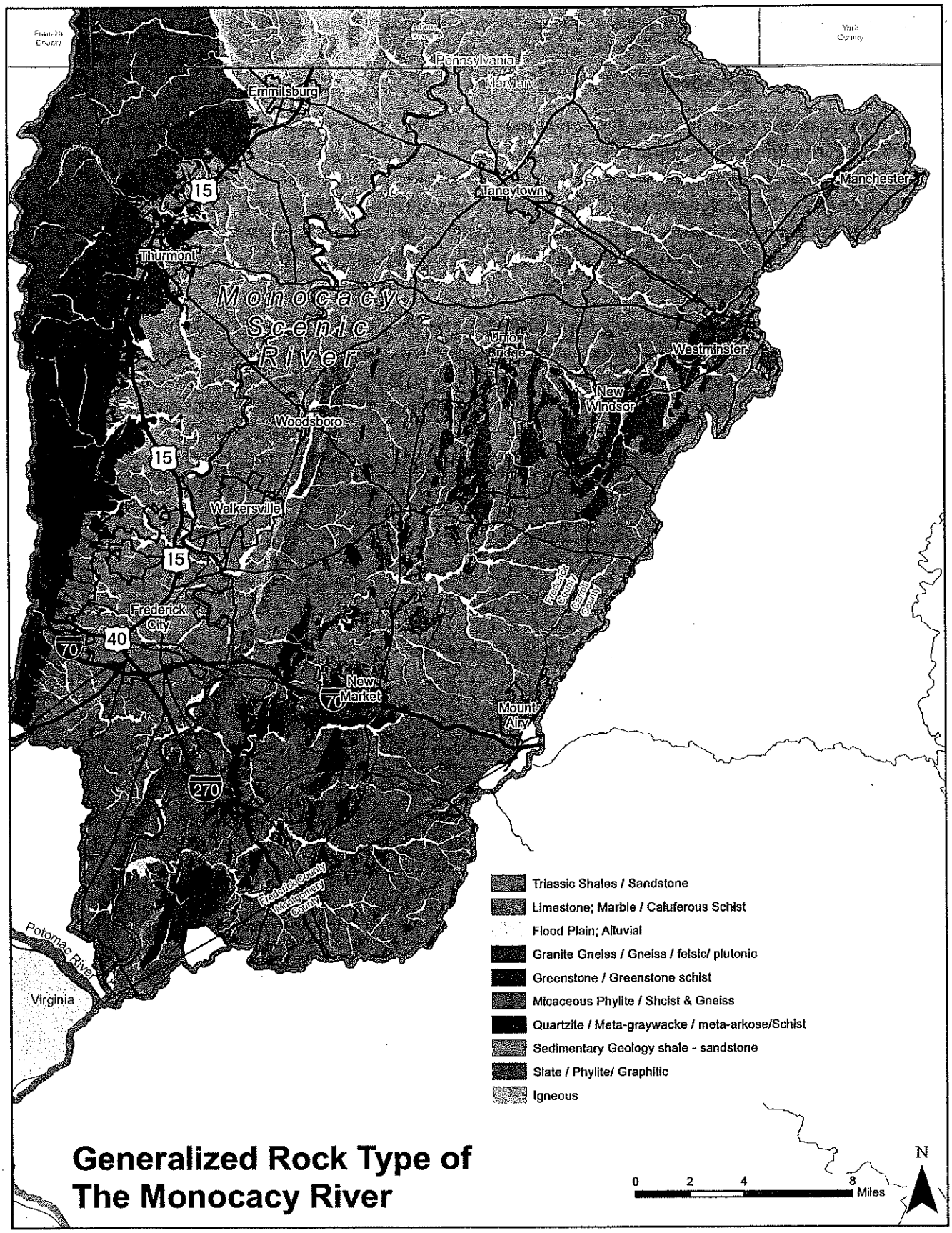
Soils

The diversity of physical and chemical soil properties found within the Monocacy watershed are derived from different rock formations (also called 'parent material') associated with the Northern Piedmont and Blue Ridge physiographic regions. Soil formation is the result of parent material, climate, plant and animal life, topography, and interactions over time. The parent material is still the most important factor in soil classification; consequently soils are subdivided by geological parent material. Soil health and it's physical characteristics are critical to biomass production, rainfall infiltration, nutrient/pollutant filtration and ultimately stream/river water quality. The impact of erosion on soil health can be minimized by reducing the amount of time bare soil is left unvegetated during urban development projects and agriculture practices.

During periods of rainfall, some shallow, erodible soils are washed into the Monocacy River and its tributaries, resulting in sedimentation and nutrient loading into the surface water. When erodible soils are disturbed for urban development or agriculture, the potential for erosion substantially increases. Proper land management allows biological activity to thrive, which can lead to an increase of organic matter in the soil profile. This increase in organic matter improves water infiltration/ storage and nutrient absorption throughout the watershed and particularly along riparian areas, which are represented as floodplain/alluvial on the map associated with this section.



Regions within Physiographic Provinces
The Monocacy River Watershed


Pennsylvania
Maryland
Emmitsburg
Taneytown
Manchester
Thurmont
Monocacy
Scenic
River
Union
Bridge
Westminster
New
Windsor
Woodsboro
Walkersville
Frederick
City
New
Market
Mount
Airy
Frederick County
Carroll County
Frederick County
Montgomery County
Potomac River
Virginia
15
70
40
270
Triassic Shales / Sandstone
Limestone; Marble / Caluferous Schist
Flood Plain; Alluvial
Granite Gneiss / Gneiss / felsic/ plutonic
Greenstone / Greenstone schist
Micaceous Phylite / Shcist & Gneiss
Quartzite / Meta-graywacke / meta-arkose/Schist
Sedimentary Geology shale - sandstone
Slate / Phylite/ Graphitic
Igneous
Generalized Rock Type of
The Monocacy River
0 2 4 8
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N

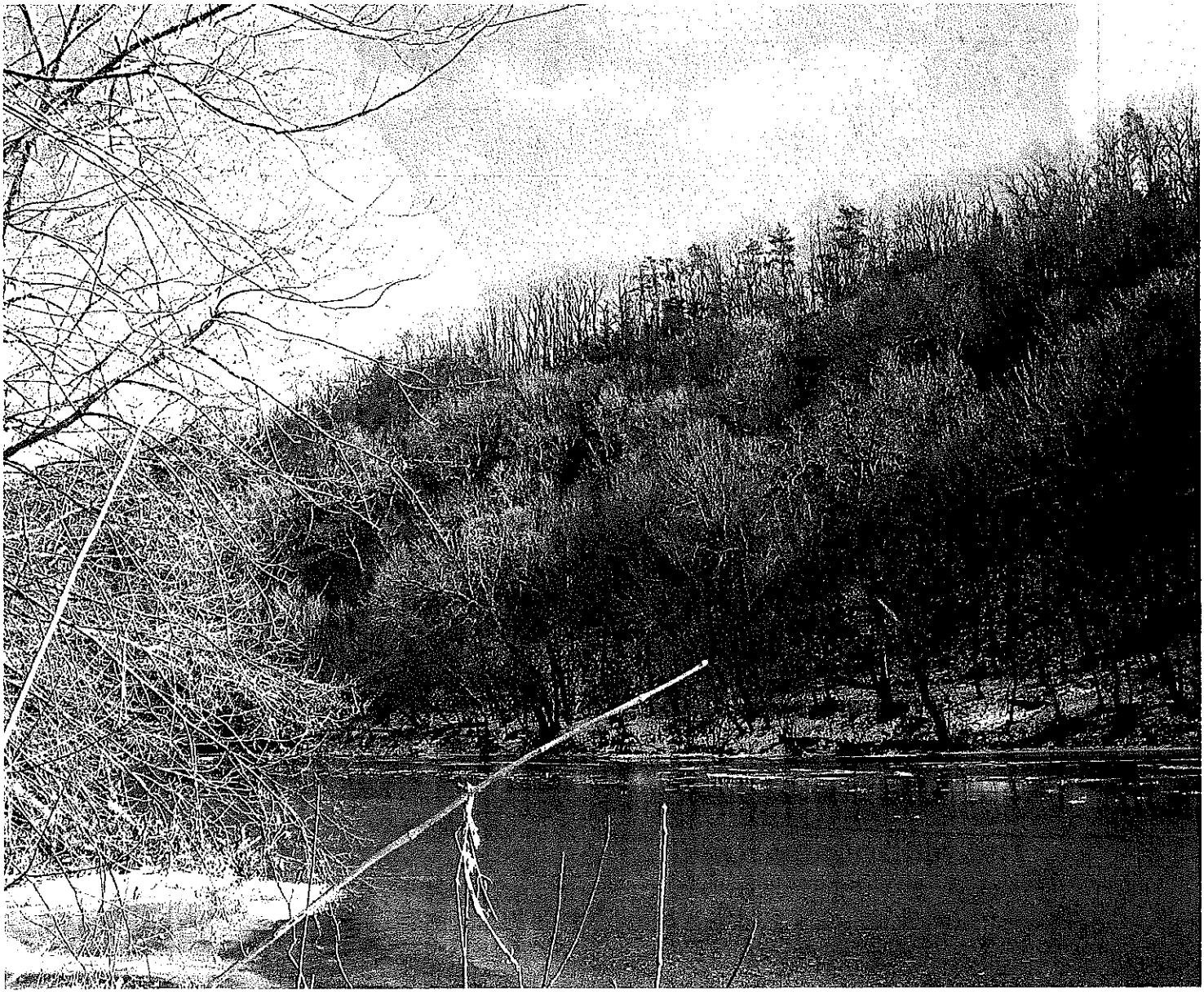
NRCS Web Soil Survey Printable reports of your soils: http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm
NRCS SoilWeb General info of soil maps for your smart phone: http://casoilresource.lawr.ucdavis.edu/soilweb/

Hydrology- Ground and Surface

The hydrologic or water cycle describes the continuous movement of water above and below the surface of the earth. When rain or snow falls onto the surface one of three actions may occur. These actions include: Re-evaporation back into the atmosphere; Run-off to streams and rivers; Infiltration into soil where it may be taken up by plants or slowly moving to groundwater aquifers. Aquifers in the watershed partially contribute to the discharge (flow) and water quality of the Monocacy River. If a source of groundwater is contaminated by pollution, there is a possibility that the contaminants will eventually reach the stream. (4)

The surface water system of the Monocacy River basin is extensive. The Monocacy is well known as a flat, slow moving river, subject to periods of high turbidity and rapidly changing water levels during heavy rainfall. Over 75 percent of the watershed is in Maryland, while the remainder is in Pennsylvania. Approximately 1,700 miles of streams feed into the large tributaries of the Monocacy

Steep slopes adjacent to the River



River. The major Monocacy River tributaries include: Rock Creek, Marsh Creek, Piney Creek, Tom's Creek, Double Pipe Creek, Owens Creek, Hunting Creek, Fishing Creek, Tuscarora Creek, Carroll Creek, Israel Creek, Glade Creek, Linganore Creek, Bush Creek, Ballenger Creek, and Bennett Creek.

We Live in a Watershed

A watershed is simply an area of land that drains into a creek, river, or lake. Watersheds can be as small as your backyard or contain millions of square miles, depending on how one measures the water drainage paths or run-off flows of a particular land area. The Monocacy River Watershed is 970 square miles or approximately 620,800 acres, extending north to Gettysburg, Pennsylvania, east to Westminster, Maryland, west to the Catoctin Mountains, and south to the Potomac River. Many sub-watersheds within the larger Monocacy River Watershed are identified by the main tributary streams that flow into the Monocacy River. Finishing its journey, the Monocacy River meets the Potomac River at the C&O Canal National Park, and eventually flows into the Chesapeake Bay. Therefore, in the Monocacy River Watershed, we all are connected to the Chesapeake Bay.

The Monocacy River's water comes from all the tributary streams present throughout its watershed that eventually flow into the mainstem of the River. Some of the Monocacy's tributaries are large, fifth order (or higher) streams that have miles of smaller streams that flow, converge, and grow into larger streams that eventually empty into the Monocacy River. Some tributaries that flow directly into the Monocacy River are relatively small, first or second order streams draining just a few hundred acres or less.

Wetlands – Springs and Seepage Areas

Hydric soils, vegetation, and hydrology are some of the resources analyzed to classify wetlands. Wetlands have several major functions. They serve as habitat and breeding grounds for wildlife, and the dense and complex vegetation absorb and filter nonpoint pollution runoff. Wetlands also reduce flooding and recharge groundwater supply. (5)

Riverine, lacustrine, and palustrine are the most common wetland types in the Monocacy watershed. The riverine includes the Monocacy River and its tributaries. Lake Linganore, a reservoir located east of the City of Frederick, is a good example of a lacustrine system. The lacustrine system consists of large open bodies of water such as lakes, ponds, and reservoirs that are usually the result of a dammed river channel. Palustrine forested wetlands refer to wooded flood plain, swamps, and associated emergent vegetation.

One interesting aspect of the watershed is its abundance of springs and seepage areas which often are classified as a wetland type. With the exception of Fountain Rock Spring, which produces over a thousand gallons of water per minute, springs and seepage areas are usually small, but differ primarily in their degree of permanence and nature of flow. Springs flow throughout the year, while seepage areas are typically dry during the summer and fall and always exhibit a seeping flow with no defined single point of discharge. However, springs and seepage areas do have the same important, cooling effect on the streams that they enter. (6)

Springs and seepage areas are often highly restrictive to the special species that dwell within them.

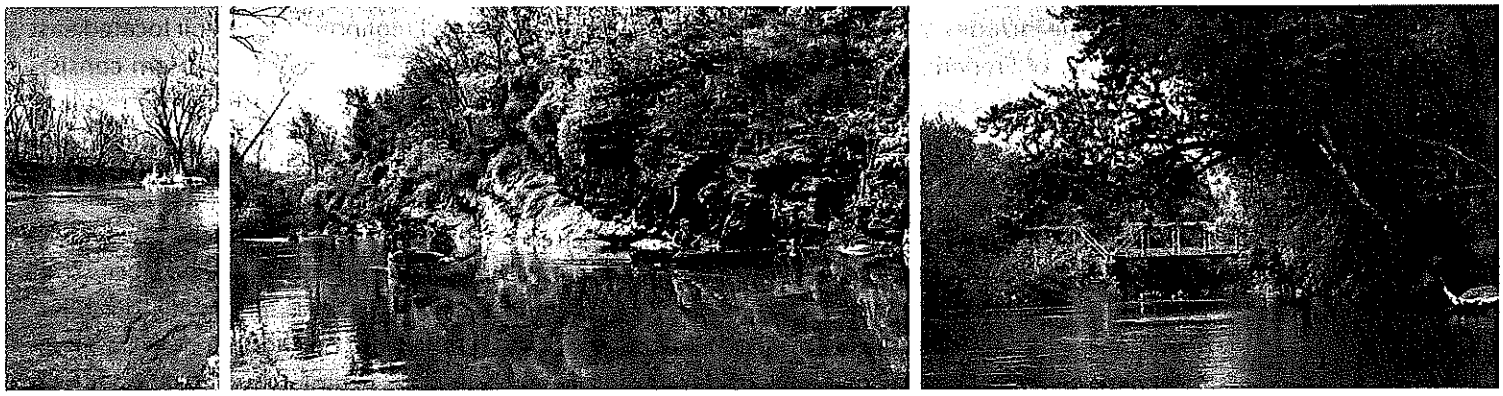
These resurgences of cool groundwater impart many streams with year-round cool water conditions that make possible the survival of such stenothermic species as Brook Trout and Pearl Dace—fish that can only survive in a narrow range of temperature conditions.

River and Riparian Ecology

Rivers, sometimes called inland water systems, are part of the larger terrestrial landscape and are distinctly linked to their upstream catchments, or watersheds. Thousands of miles of streams within the Monocacy River Watershed flow and receive inputs—nutrients, sediment, pollutants, trash—from all the land within the watershed that eventually drains into the Monocacy River, as streams and rivers generally lie at the lowest points on the landscape. Therefore, for rivers, water is generated 'outside' the river system itself and enters primarily via tributary streams flowing across and through the surrounding watershed and, secondarily, through subsurface pathways. Streams and rivers 'collect' everything we do and deposit on the land. Numerous tributaries join the Monocacy River as it winds through our region. These tributaries begin as headwaters at the top of the watershed, merging with other streams until they finally reach the Monocacy River

A river system—its water, channel, banks, and adjacent land (called 'riparian' areas)—is a rich and diverse ecosystem, defined by the International Union for the Conservation of Nature as a "dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit." Riparian areas are places where the terrestrial meets the aquatic and include a variety of habitats, unique soil types, vegetation, animal communities, water regimes, and biogeochemical processes (e.g., nutrient cycling, chemical transformations, decomposition). A river system is rich in biodiversity—the variability among organisms, species, habitats or ecosystems.

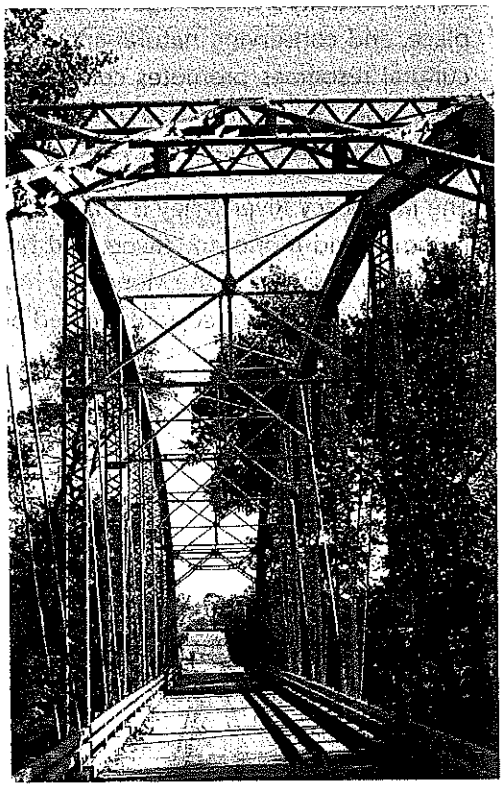
A river's structure, function and overall ecology is driven by hydrological processes—water/flow regimes—the magnitude, frequency, timing, and duration of water inputs and flows. A river system needs space to adjust to varying flow rates and storm events in order to efficiently transport and store water, sediment, and woody debris without excessively scouring the river bed and river banks.



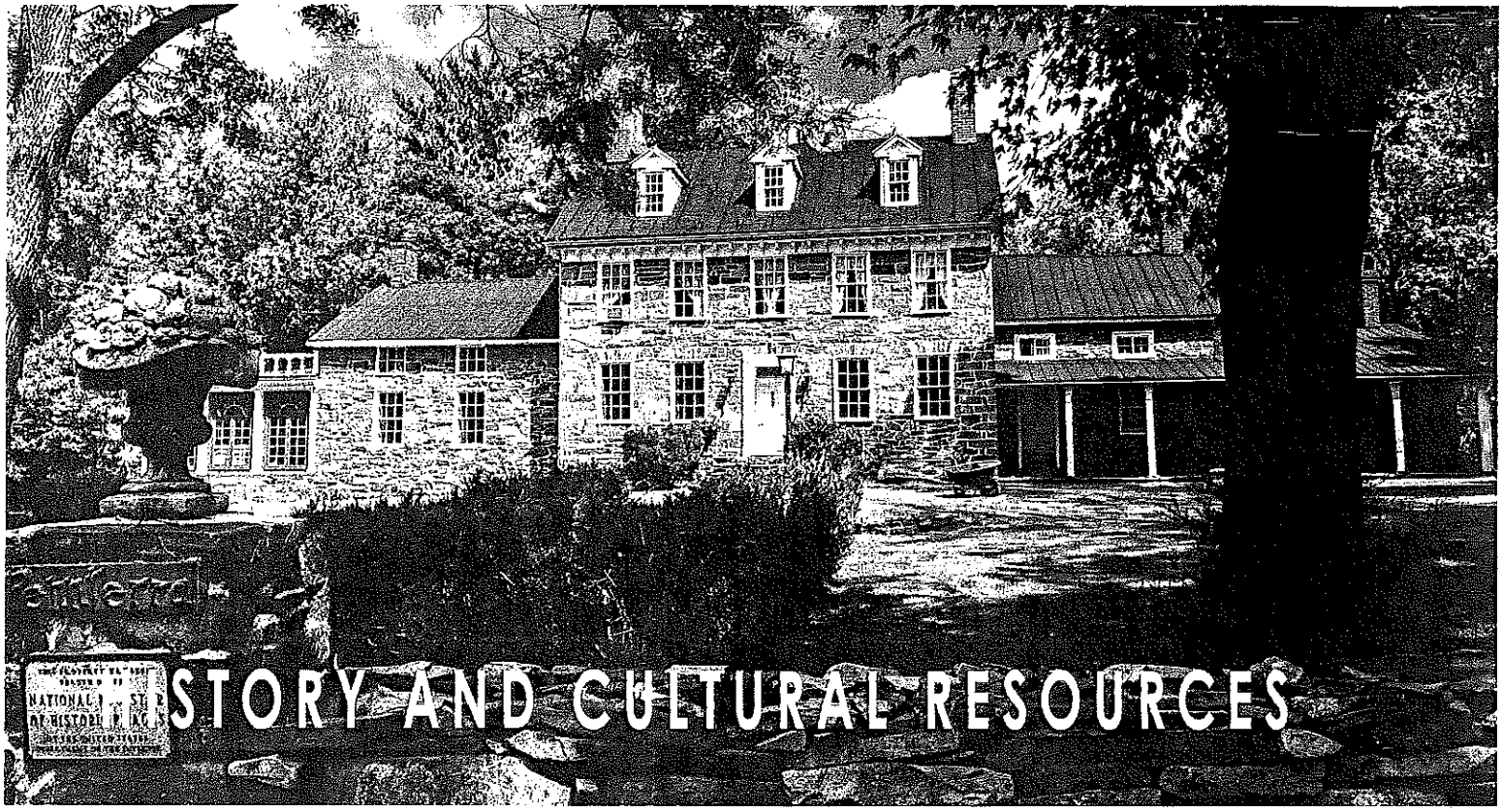
Sixes Bridge Road

[illegible] the natural resources
[illegible] over to the next generation
[illegible] impaired in value

Theodore Roosevelt



Bullfrog Road Bridge
over the Monocacy River



STORY AND CULTURAL RESOURCES

Photo by Dial Keju

Archaeological and historic resources are irreplaceable components of local heritage, and once destroyed, cannot be replaced. Over three decades ago, in 1981, a nationwide river study conducted by the National Park Service identified the Monocacy River as an outstanding archaeological resource of national significance. The Maryland Scenic and Wild Rivers Act's "Declaration of Policy" makes specific reference to the importance of recognizing the outstanding "historic values" of a designated scenic river and its adjacent lands.

Why is this important to the residents of Frederick and Carroll Counties? The preservation of historic and archaeological resources contributes to the quality of people's lives by increasing the community's knowledge of its heritage, providing residents and visitors with a rich sense of place, and conserving natural and cultural resources. Acknowledgment and care of historic and cultural resources promotes community pride and can vastly improve the visual quality of the landscape. Preservation also serves as an important driver of regional tourism and related economic development activities.

The Monocacy River Valley is an area rich in cultural history. Native Americans caught fish in the Potomac and Monocacy Rivers and hunted for an abundance of wild game. European settlers were also attracted to the Monocacy region for the same reasons. By the time Frederick and Carroll Counties were chartered, farming had become the local economic mainstay.

Early historical uses of the area's land and water resources have shaped land use and development patterns that are still prevalent today. As the region grows and changes around us, the historical and cultural resources along the Monocacy River continue to offer a fascinating glimpse into the recent and distant past.

Archaeological Summary

Pre-European Settlement

The Monocacy River Valley, which extends through the center of Frederick County, has been the

area of most intense archaeological investigation. The following discussion of the archaeological chronology is based largely on the 1980 study Prehistoric Occupation of the Monocacy River Region by Maureen Kavanagh. The conclusions on distribution of sites, dates of occupation, and types of artifacts are presumed to apply in general terms to the prehistory of the Middletown Valley. The area west of Catoctin Mountain remains largely untested, although scattered site reports in the area exist in the files of the Maryland Historical Trust's Office of Archeology.

Below is a brief chronology of the archaeological and historic periods of the region.

Paleo-Indian Period (10,000 – 7,500 B.C.)

The Monocacy River Valley of 10,000-12,000 years ago was most likely predominantly covered by a rich deciduous forest cover along the river. The uplands were probably boreal forest and open areas, which were indicative of a colder climate. This period constitutes the earliest documented era of human occupation in the County. Scattered discoveries of fluted projectile points in small numbers indicate that a very sparse population was present in the Monocacy River Valley during the period. The majority of the points were found near the Monocacy and Potomac Rivers, suggesting that most camping and/or hunting activities occurred within a short distance of the waterways. Early climatic conditions during this period indicate a deciduous forest lining the rivers and a mixture of boreal forest and open areas in the uplands. A small population, centered in the Potomac Valley and which made occasional forays into the Monocacy Valley and Middletown Valley (following Catoctin Creek), was apparently active during the Paleo-Indian period.

As this period drew to a close, the Native Americans appear to have remained closer to the river in order to hunt, fish, and camp.

Archaic Period (7,500 – 2,000 B.C.)

There are numerous Archaic Period sites in the Monocacy area. As this period experienced a climatic warming trend, vegetation may have changed to pine and hemlock in mountainous regions, and to a mix of conifer and deciduous forest in the river valley. As the warming trend continued, so did the changes in vegetative cover and human migration.

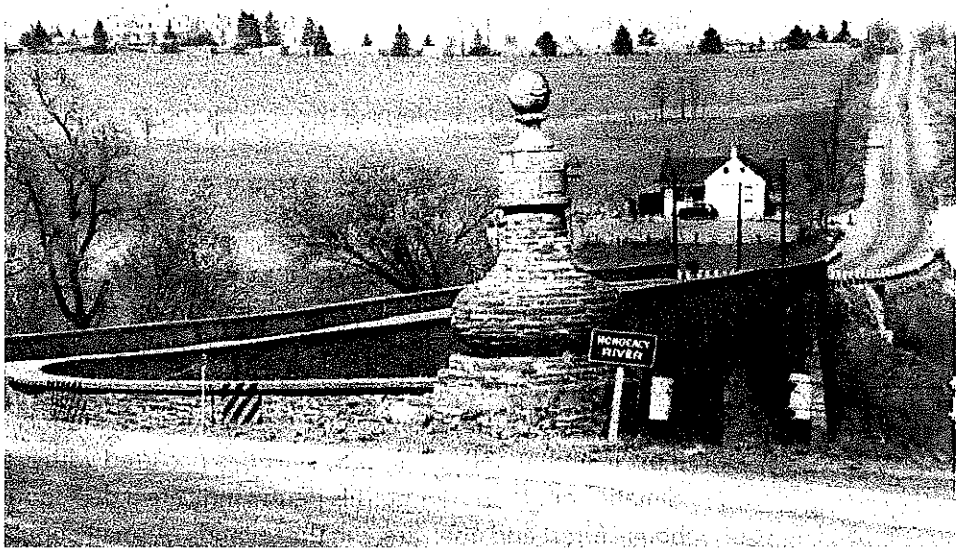
During the Early Archaic (7,500-6,000 B.C.) and the Middle Archaic (6,000-4,000 B.C.) Periods, the orientation of early peoples continued to be toward riverine sites with evidence in the Early Archaic Period that occupation extended into the northern Monocacy Valley. Rhyolite, a volcanic rock which splits easily, was used extensively for points and tools during these periods. The Catoctin Mountain ridge and western Monocacy Valley appear to have been visited on special trips to gather these rocks. In the Middle Archaic Period, site distribution spread into the Monocacy Valley floor, the Piedmont Uplands, and the lower hills of Catoctin Mountain. For the first time, sites in the foothills began to figure prominently in habitation patterns. There is evidence that the population began moving away from the rivers along the smaller tributary streams. The overall tendency, as seen in the clustering of sites into the center of the valley and the dispersal across the Monocacy Valley floor, is that of a population beginning to concentrate itself rather than using the Monocacy River merely as an extension of the Potomac Valley.

In the Late Archaic Period (4,000-2,000 B.C.), an increase occurred in the types of projectile points and a trend, begun in the Middle Archaic Period, continued in terms of site distribution—movement away from the rivers. Sites were clustered along the foothills of the Catoctin Mountains, along the Monocacy River, and on Israel Creek adjacent to the Piedmont Uplands while the northern foothill area of the Catoctins was extensively used for the first time. The overall increases in points styles, sites,

Historic National Road

The National Road was the first federally planned and funded highway in the United States. In the early 19th century, the US Congress approved the construction of a national road, beginning in Cumberland, Maryland to connect the port of Baltimore with the burgeoning Northwest Territories. The purpose of the road was to facilitate a direct overland route by cutting straight across the Appalachian Mountains. The route was seen as a 'portage' between the waters of the Ohio and the Baltimore Harbor.

Various segments of the historic route have had other names at one time or another, such as the Bank Road, the Baltimore Pike, the Frederick Pike, the Boonsboro Pike, and the National Pike. On contemporary street maps, the historic route also goes by several names, including the Old National Pike, Western Pike, or National Pike. The route is also labeled on highway maps as MD 144, US 40, US Alt. 40 and Scenic US 40 in various segments. Maryland's Historic National Road Scenic Byway was designated an "All-American Road" by the Federal Highway Administration in 2002.

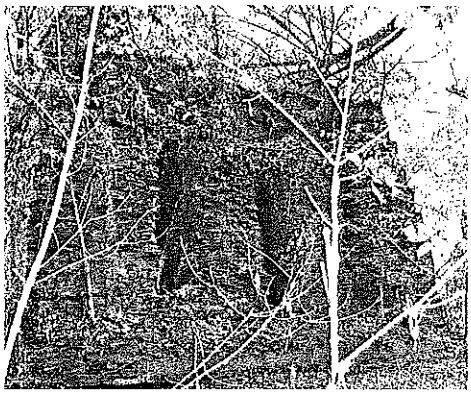


Frederick County Historical Society

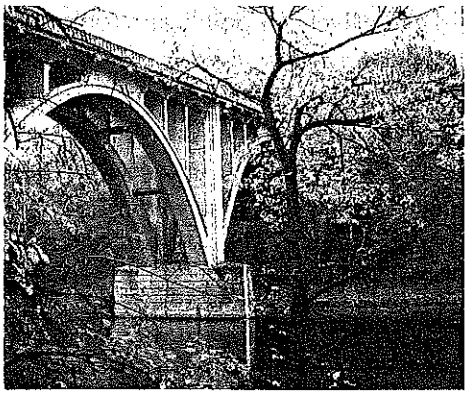
(1) The original Jug Bridge.

The Historic National Road's original crossing of the Monocacy River was called "Jug Bridge" and was designed with semicircular stone masonry arches. Its tollhouse is still standing and listed on the National Register of Historic Places (1). Remnants of the original Jug Bridge from the "Heyday" period (early 20th century) of the National Road are visible from the River, as shown (2).

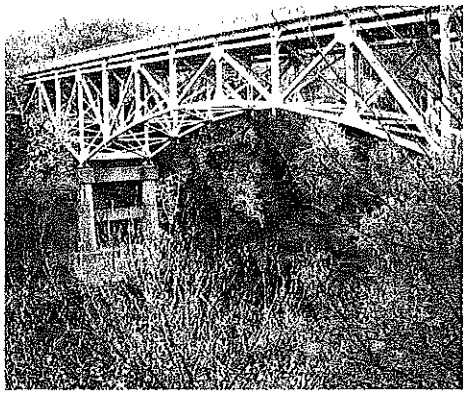
The replacement bridge is from the 'Revival' period (1920-1940) and is a concrete arch bridge (3). It remains standing, but unused, and is directly adjacent to the current MD 144, a truss bridge (4) over the Monocacy River, shown.



(2) Remnants of Jug Bridge abutment.



(3) "Revival" bridge.



(4) Current truss bridge.

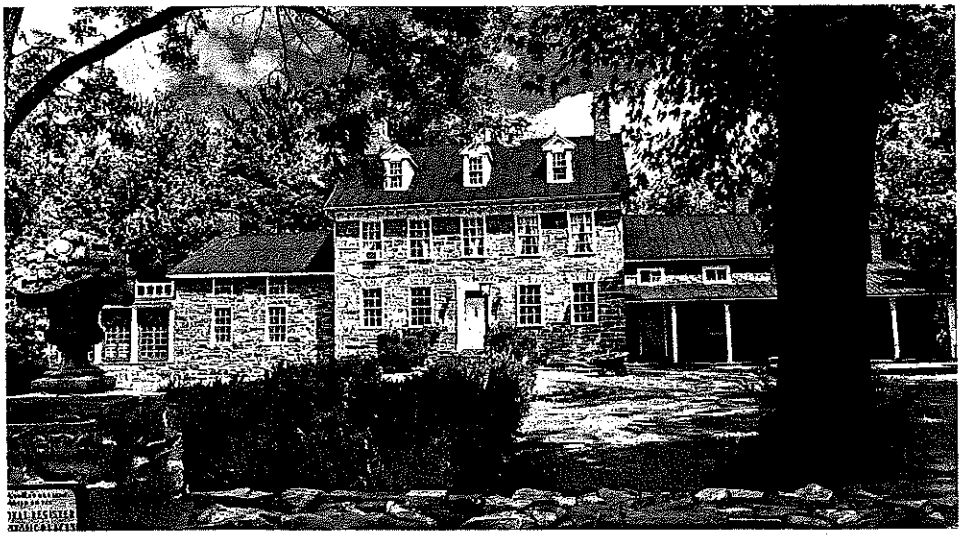
Antrim

Antrim was built in 1844 by Col. Andrew Ege (1813-1876) on land inherited by his wife, Margaret, from her father Major John McKaleb. The mansion was named in honor of the McKaleb's family ancestral home in County Antrim, Ireland. Antrim is a 2 ½-story Greek Revival style brick masonry house in Taneytown, Maryland. Many of the original outbuildings are still intact today and the mansion is operated as a hotel and restaurant.

Antrim

Penterra

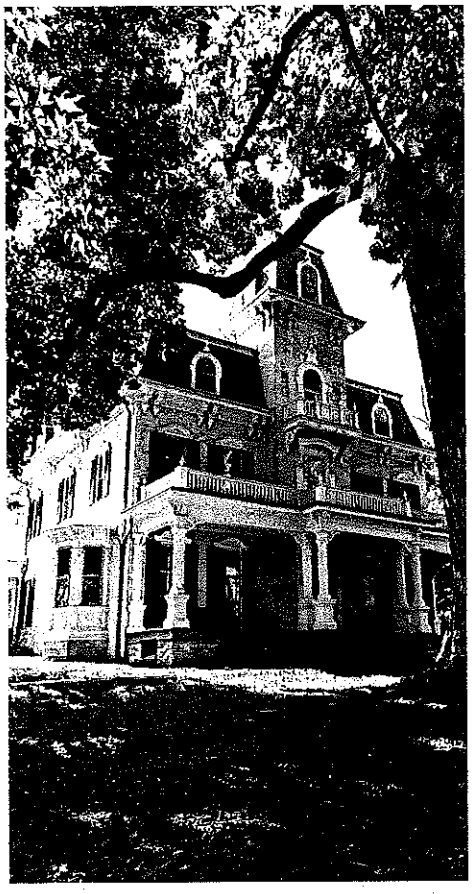
"Penterra on the Monocacy" is a 2 ½ story, late 18th century house in Creagerstown, built of stone from a local quarry. There were two additions in the 20th century, one at each end, which duplicate the earlier masonry. This Georgian style farmhouse is on the National Register of Historic Places and faces southeast towards the Monocacy River.



Penterra Photo by Dial Keju

The Gambrill Mansion

The Gambrill Mansion, located approximately 1,500 feet south of the Monocacy River/Bush Creek confluence on the Monocacy National Battlefield in Frederick, is an example of the Second Empire architectural style and one of the very few full-scale expressions of the style ever built in Frederick County. Built in 1872, it is individually listed on the National Register of Historic Places for its architectural significance. The three-story mansion has a distinctive mansard roof, a central cupola-topped tower, 17 rooms, and 7 fireplaces. The mansion stayed in private ownership until the National Park Service acquired the property in 1981. It now houses the administrative offices of the Historic Preservation Training Center. Courtesy: National Park Service



Gambrill Photo by Dial Keju

dispersals, and numbers of artifacts indicate an established progression of movement between sites within the Monocacy Valley according to seasons. This is related to the spread and ranges of some food and non-food resources as well as a more intensive use due to a larger population as a whole.

Woodland Period (2,000 B.C. – A.D. 1650)

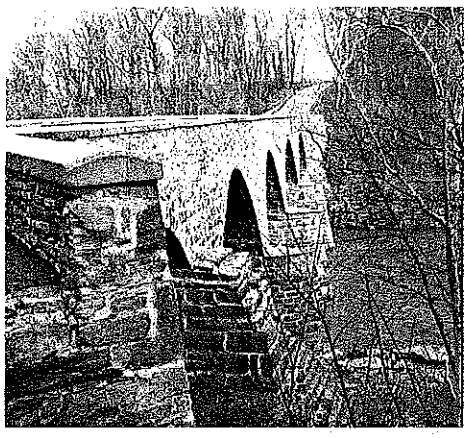
The Early Woodland/Archaic Period (2,000-500 B.C.) is characterized by a continuation of the Late Archaic site distribution patterns, with a slight trend back toward rivers for location, coinciding with a similar trend throughout the Middle Atlantic region. Large, heavily occupied sites occur along the Potomac River in the Piedmont and are possibly the more permanent habitation sites associated with the rock shelter, foothill, small habitation, and transitory sites found in the Monocacy Valley. This is the first period in which ceramic artifacts are found in association with certain types of projectile points. The earliest known occurrence is at a site on the Potomac River near the Frederick-Montgomery County border. Radiocarbon dated between 950± 95 years and 545± 95 years B.C., this is the earliest dated manifestation of pottery in the Potomac River Valley and one of the oldest in the eastern United States. Generally, the American Indians' use of resources did not change significantly during the Early Woodland Period.

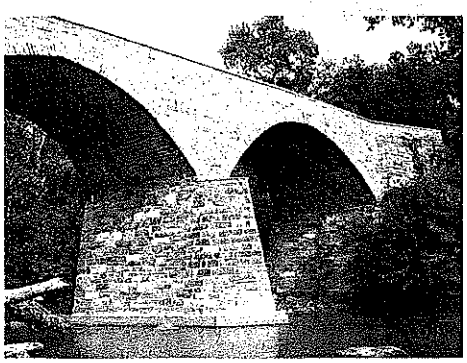
In the Middle Woodland Period (500 B.C.-A.D. 900), ceramics occur rarely throughout the Piedmont Region suggesting that, although the Potomac and Monocacy River Valley areas were occupied during this period, the use of ceramics appears to be concentrated along coastal areas. The Frederick County sites imply a seasonal rotation of hunting, gathering, and fishing, featuring small-sized sites and the reoccupation of previously-used sites. After A.D. 300, the sites in the Monocacy Valley indicate a more dispersed occupation pattern, particularly in the northern Valley. The highest number of identified archaeological sites—after the Late Archaic Period—occur in this part of the Middle Woodland Period. This is likely an indication that a larger population was operating in the Valley. The rare ceramics that do occur, are primarily in rock shelters and were probably imported by groups making forays to obtain rhyolite.

The Late Woodland Period (A.D. 900-1600) exhibits some notable changes from earlier periods including: 1) the appearance of large, permanent or semi-permanent villages associated with the cultivation of maize, beans, and squash, probably stockaded late in the period; 2) the presence of ceramics at a larger number of sites (indicative of open camps and habitations); 3) an intensification of riverine orientation increasing over time; and, 4) a shift to primary use of quartz for projectile points, suggesting a breakdown of the rhyolite procurement network which had been in existence since the Early Archaic Period. During this period, the Noland's Ferry site near the present Tuscarora—in use since the Paleo-Indian Period—was occupied by a village laid out in a circular pattern around an open plaza. The existence of limestone-tempered pottery places the site's most intensive use between A.D. 1350 and 1450. A similar village site at Biggs Ford near Walkersville, dated about

LeGore Bridge

LeGore Bridge, a stone arch masonry bridge over the Monocacy, was constructed by James W. LeGore in the late 19th century. LeGore was not an engineer by training, and probably used a very basic telescopic level to align the placement of the piers, while overseeing much of the original construction. Placed on the National Register of Historic Places in 1978, LeGore Bridge has no steel; mortar holds the stones together. In 2009, Frederick County invested nearly $1 million to rehabilitate and repair this unique, historic structure by replacing mortar work and some masonry stones, upgrading the drainage for the travel surface, and making other repairs. The bridge's stone construction is not subject to corrosion like concrete or steel bridges, and could remain standing for another 100 years, according to Frederick County Division of Public Works.





A.D. 900-1500, shows relationships between the Potomac, Susquehanna, and Ohio Valley cultures. The northernmost village site of the period that has been discovered is the Shoemaker III site (A.D. 900-1300) near Emmitsburg. The best-preserved late prehistoric Native American village site in the Monocacy Valley and possibly in Maryland is the Rosenstock site, near present day Clustered Spires Golf Course. Excavations reveal a site occupied from A.D. 1100-1450, with several shallow semi-subterranean structures, large pits once used for storage but now filled with refuse, an area of surface refuse, and human burials. The refuse includes Shepard ware pottery shards, projectile points, clay pipe fragments, other stone and bone tools and ornaments, bones of food animals, and charred beans and corn. The site is unique among the other identified village sites in that it is a single component, with no evidence of occupation in earlier periods as would be shown in stratified layers or scattered artifacts of mixed periods.

The Late Woodland Period is perhaps the best documented of the American Indian periods. It was during this time that many of the tribal groups had names that are still recognized today. The major change during the Late Woodland Period was the presence of permanent or semi-permanent villages or settlements in the valley. Although wild game was plentiful, there was an increasing reliance on the use of domesticated plants such as corn.

Contact & European Settlement Period (1700-1730)

In about 1621, Captain Henry Fleet of the Jamestown settlement in Virginia sailed up the Potomac River on an expedition to buy corn from the American Indian people in the area. During several subsequent trips, he probably reached the vicinity of present Frederick County. Fleet's 17th century description of the upper waters of the Potomac River testified to a rich landscape, teaming with native species of animals and plant life:

"The place is without question, the most healthful and pleasant place....And for deer, buffaloes, bears, turkey the woods do swarm with them and the soil is exceedingly fertile..." (8)

The first recorded attempt to penetrate the Monocacy watershed was by several missionaries, who established an outpost on the Monocacy River (8). Other infrequent visitors and an occasional fur trader or missionary expedition are known to have been in the area during the period up to 1720, but the Piedmont Region remained largely wilderness until the third or fourth decade of the 18th century. In 1707, Louis Michel, a Swiss explorer, made a map of the Potomac which showed an American Indian village near the Noland's Ferry site, drawings of game animals of the area, and the major mountain chains including Sugarloaf Mountain. In 1712, Baron Christopher von Graffenried scaled Sugarloaf to view the panorama of the area, which became Frederick and Montgomery Counties in Maryland, and parts of Virginia and West Virginia. His map was the first to identify the mountain by name and also showed planned settlements of Swiss immigrants which never materialized.

Beginning in the 1720's, surveys were applied for and certified from the Proprietary Government's Land Office for Western Maryland. In spite of increased land transfers, the area of the present Frederick County (at that time still part of Prince George's County) remained sparsely settled and the land mostly unproductive in European economic terms. By about 1730, several large tracts had been purchased by investors, including Carrollton in 1723 by Charles Carroll the Settler (10,000 acres), Merryland in 1730 (6,300 acres), Tasker's Chance in 1725 (7,000 acres, part of which was the site of the future Frederick Town), and Monocacy Manor in 1724 (10,000 acres).

During the 17th and 18th centuries, several American Indian tribes periodically inhabited the region. The Seneca Indians called the Monocacy River Valley "Cheneoowquoque". The Shawnees called

the river and adjacent land "Monnockkesey," while early European explorers called it "Quattaro," the derivation of this name remaining a mystery. Eventually the name evolved to Monocacy. During the early 18th century, and for some time after, "Monocacy" not only referred to the river but to the surrounding valley and a local village.

In 1702, a Swiss explorer, Franz Louis Michel, visited the Monocacy River Valley while searching for silver. Five years later, Michel drew a map that clearly depicted the Potomac River, the River Quattaro (Monocacy) and Sugarloaf Mountain. During his 1707 exploration, Michel traveled through the southeastern part of the Monocacy watershed, and then may have traveled up the western side of the Monocacy to Hunting Creek (9).

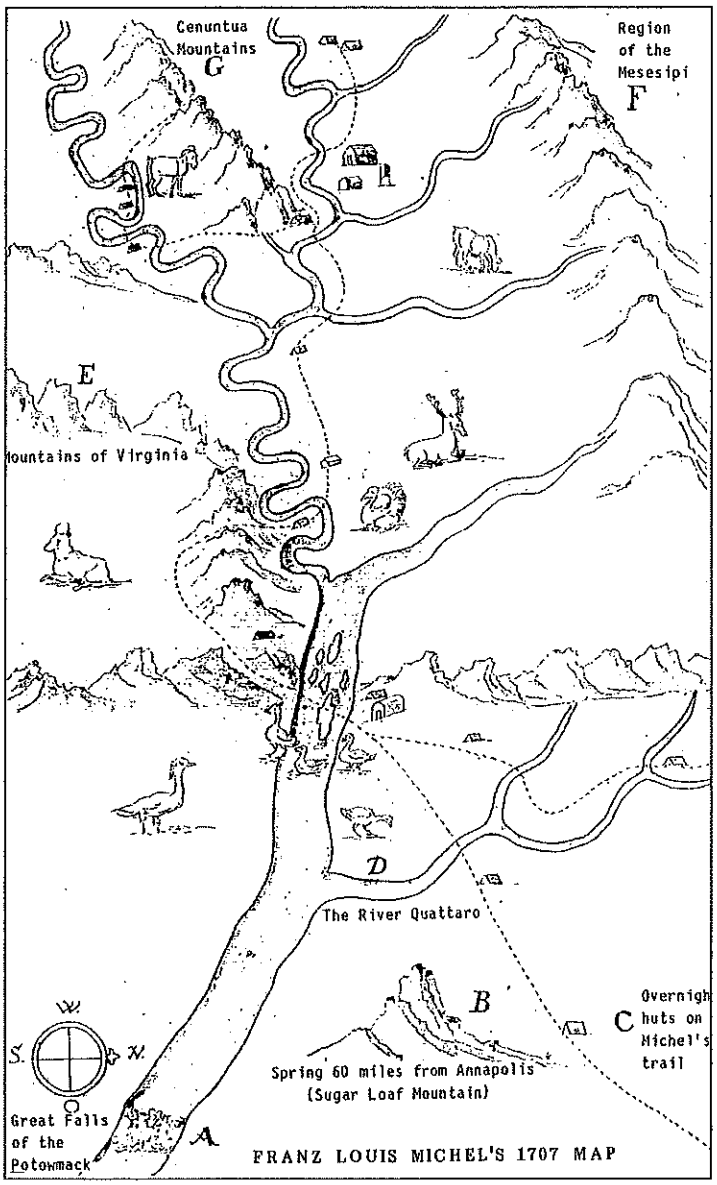
Michel's interest in further exploration of the region was financed by Baron Christoph von Graffenried, who, after unsuccessfully settling in the colony of North Carolina, moved north to resettle in what is now southern Frederick County. After climbing Sugarloaf Mountain, Graffenried recorded, "I believe there is hardly any place in the world more beautiful and better situated than this of the Potomac and Canavest." ('Canavest' being an area west of the Monocacy River).

Traders typically followed explorers, and Chartier, a French trader, established himself near the mouth of the Monocacy. The natural environment, as seen by the Indians, quickly changed as the pace of colonial settlement escalated. Distinct settlement patterns developed in the northern and southern parts of the Monocacy River basin. Early English land patents consisted of large holdings in the south. As Germans migrated from Pennsylvania down through what is now Carroll and Frederick Counties, smaller farms became the more predominant rural feature in the north.

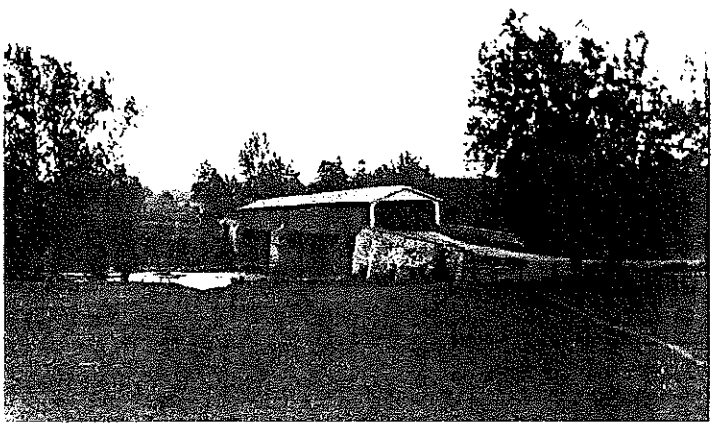
River Crossings

Unlike other streams and rivers, the Monocacy River, which flows in a generally southerly direction through the heart of Frederick County, was not itself a route of travel. Instead, it was a river to be crossed. This in turn led to the practice of referring to all roads leading toward the Monocacy or its general region as the "Monocacy Road." There was, in other words, no one "Monocacy Road." (9)

Because the Monocacy River had to be crossed, the general direction of paths and the roads which succeeded them were often by where the Monocacy could be



From Pioneers of Old Monocacy



19th Century bridge over the Monocacy near present day MD355.

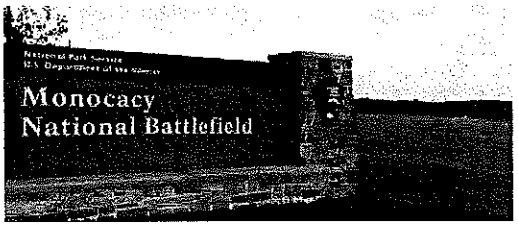
forded. The first mention of one of these fords in the early records' in a 1725 Act of the Maryland Assembly describing the backwoods as lying "northwestward of Monocacy River from the mouth thereof, up the same River to the fording place where the Conestoga Path crosses the same, near one Albine's Plantation, and then to the northwestward of the said Conestoga Path until it meets the Susquehanna River." (9) The fording place to which this referred was near the mouth of Linganore Creek and is known today as Hughes Ford.

In addition to the Hughes Ford crossing, five other important fords across the Monocacy were mentioned in early records:

1. At the mouth of the River where it joins the Potomac
2. Middle Ford where today's Rt. 28 crosses the River in southern Frederick County
3. At His Lordship's Manor, now marked by Biggs Ford Road, west of Walkersville
4. Ogle's Ford—today's Stull's Ford west of Legore Bridge
5. Ogle's Wagon Ford Road, which is today's Mumma Ford

More settlers continued to arrive in this region, and by 1748, Frederick County was formed from Prince George's County, and Fredericktown was designated as the county seat. The western portion of present day Carroll County continued to be part of Frederick County during this period.

Originally, the Carroll County land area was located in what was then Baltimore and Prince George's Counties. The northern part of Carroll County was rapidly settled. In-migration around the upper reaches of the Monocacy watershed included the Germans and Scottish-Irish from the north and the English, who came from other parts of Maryland and Frederick. James Carroll received a sizable land patent in the New Windsor area in 1727. Other notable land patents included Taneytown, the first town, and the town of Westminster, formerly known as Winchester. Quakers settled in the Union Bridge area in what was once known as Pipe Creek Settlement. The Union Bridge Quakers were active in the movement to abolish slavery, and in 1826, an anti-slavery society was formed at the Pipe Creek Meeting House.

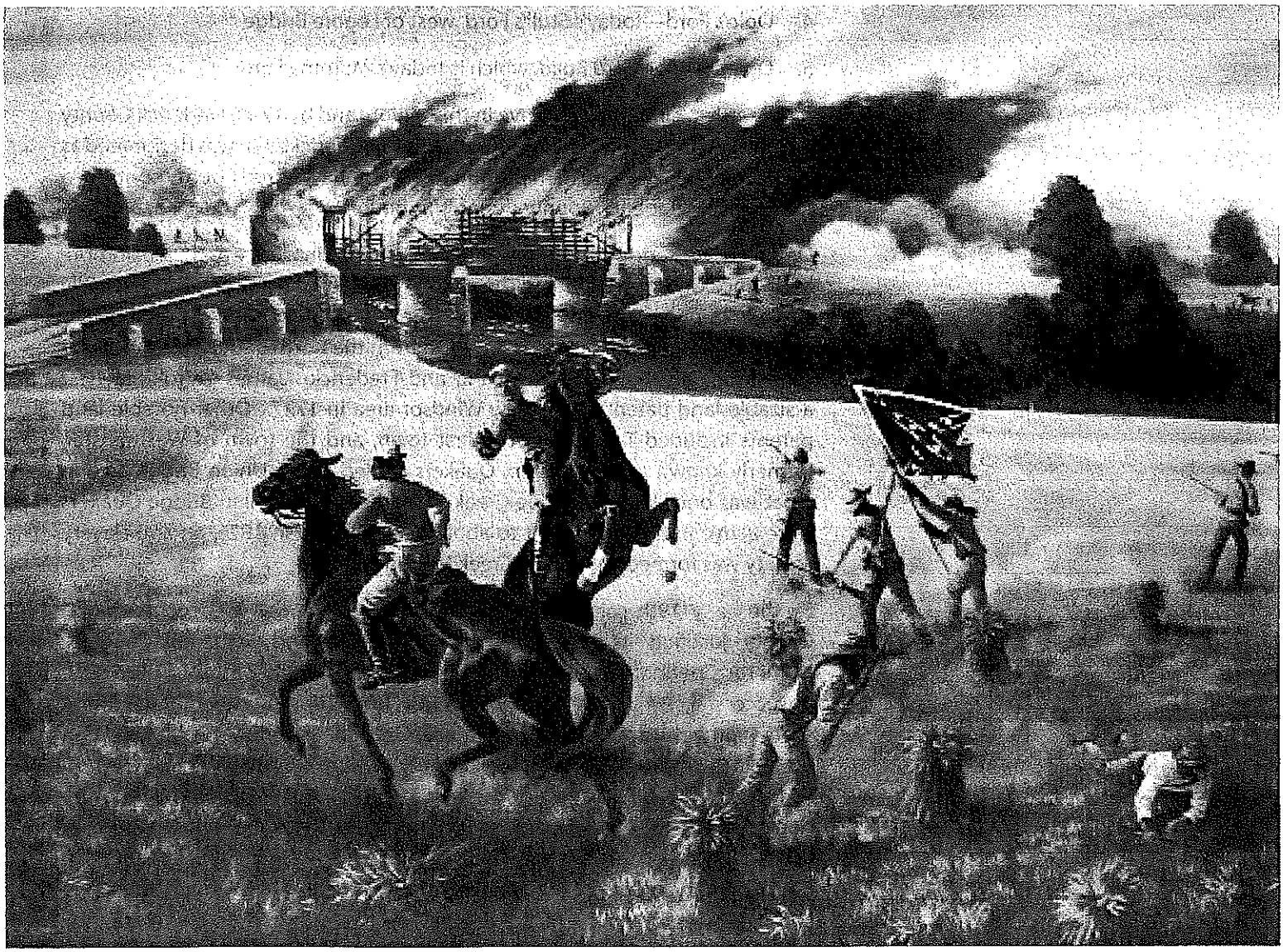


By the early 19th century, growth in the area that was to become Carroll County justified its separation from Baltimore and Frederick Counties. Numerous petitions were made to create a new county seat, but they were unsuccessful. An increase in population, long trips to other government seats, and under-representation in the General Assembly finally provided the political momentum for Carroll County to be established in 1837. The bill stated that the boundaries for the new county"... are contained within the bounds and limits following... beginning at the Pennsylvania line, where Rock Creek crosses said line, thence with the course of said creek until it mergers in the Monocacy River... to the point where Double Pipe Creek empties into the Monocacy..." (10)

The Civil War/Monocacy National Battlefield Park

The start of the Civil War saw the citizens of Fredrick and Carroll Counties divided on the issue of secession from the Union and the question of slavery and the rights of free blacks. Despite the local formation of Union companies, the federal government exerted pressure to ensure that Maryland did not secede from the Union.

During the war, both counties experienced numerous confrontations between Union and Confederate troops. Monocacy National Battlefield (originally Monocacy National Military Park) was created by Congress on June 21, 1934 to commemorate the Battle of Monocacy fought on July 9, 1864. Here, a small Union army successfully delayed a larger Confederate force advancing on Washington, D.C. This delay provided Union General Ulysses S. Grant sufficient time to reinforce defenses at the nation's capital and prevent its capture. Because of this, Monocacy came to be known as the "Battle that Saved Washington, D.C." The park comprises 1,647 acres where visitors can experience a historic landscape, structures, and transportation routes that have changed little since the battle. As a result, it offers many opportunities for understanding the Civil War within the broader context of American history and the evolution of settlement in the region. Since opening



to the public in 1991, the National Park Service (NPS) has acquired all the component properties that make up the battlefield's historic landscape, concluding with the purchase of the Thomas Farm in 2001. Much of the remaining land within the boundary that is not owned by the NPS is preserved through easements.

The Battle

In July of 1864, the Monocacy River played a critical role in the protection of Washington D.C. As Confederate General Jubal Early's army of roughly 15,000 men advanced down the Shenandoah Valley towards Harpers Ferry, and the lightly defended Union capital, Union General Lew Wallace and his force of roughly 6,600 men established a defense along the river at Monocacy Junction. Utilizing the terrain, Wallace positioned his troops on the high ground near the covered Georgetown Pike bridge (present-day Maryland Route 355) and the Baltimore and Ohio railroad bridge (present-day CSX railroad).

On the morning of July 9, Confederate forces moving toward the Junction quickly realized that the two bridges spanning the river could not be taken without severe losses. Since the river provided a natural barrier that prevented large numbers of troops from crossing near the Junction, Confederate cavalry eventually had to find a crossing at the Worthington Ford more than a mile downstream. After driving off Union cavalry guarding the ford, Confederate cavalry, infantry, and artillery slowly waded across the river and organized on the Worthington Farm.

A series of attacks were launched from the Worthington Farm throughout the day, with the final attack coming at around 3:00pm. After being aided by an artillery bombardment from across the river to the north, Confederate troops were able to break the Union lines and force them to retreat from the battlefield around 5:00pm. Although victorious, the Confederate army was forced to camp on the battlefield that night, significantly delaying their planned attack on the capital. As a result, the Confederates were unable to reach Washington, D.C. before Union reinforcement arrived from Petersburg, VA.

Natural Resources

Although established to commemorate an important historic event, the battlefield is made up of significant natural resources as well. These resources are an integral part of the cultural landscape that allows visitors to connect with the history of the battlefield.

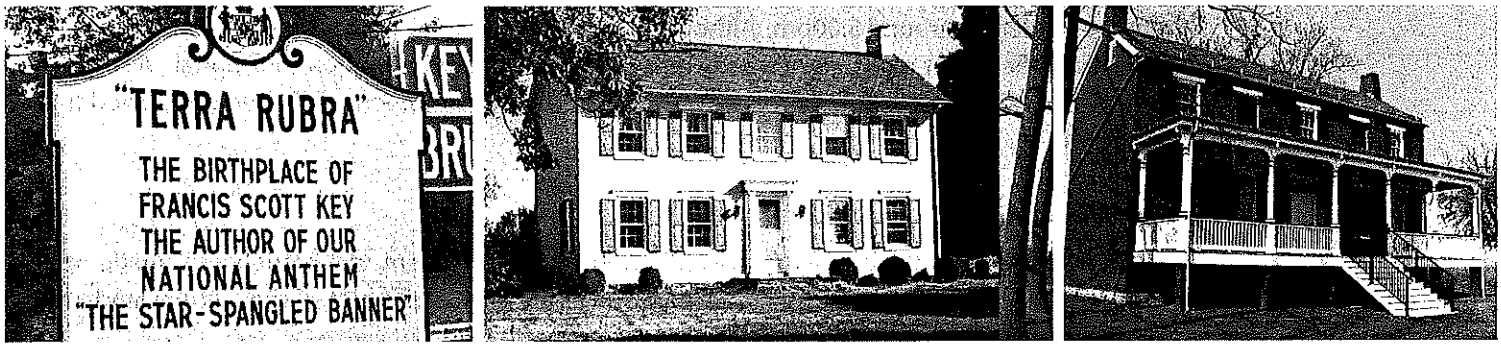
Geology - The battlefield's geology consists primarily of limestone, shale, sandstone, blue, purple, and green phyllite, slate, and quartz. Alluvium surface deposits are contained mainly in the river valley, and consist of clay, silt, sand, gravel, and cobbles. The river's floodplain through the battlefield is primarily broad and prone to extensive flooding during large precipitation events or episodes of rapid snow melt. In some areas of the floodplain, alluvial deposits can be as much as 20 feet thick.

Water Resources - The battlefield lies within several watersheds, including the Lower Monocacy River and Potomac River drainage basins, and the Chesapeake Bay watershed. Over two miles of the Monocacy River, which bisects the park from northeast to southwest, and over three miles of its tributaries flow through the battlefield. The largest of the tributaries is Bush Creek, which empties into the Monocacy near the Gambrill Mill. According to the U.S. Fish and Wildlife Service's National Wetlands Inventory (NWI) database, there are approximately 113 acres of wetland area within the boundary of the battlefield, mostly classified as forested wetlands along the river and its tributaries.

Vegetation - The battlefield's vegetation composition and the mix of forested areas, open meadows, and agricultural fields are characteristic of the regions' rural, agricultural landscape. Approximately 33

percent of the park is forested, while more than 60 percent is either open meadow or in agricultural production. This matrix of different land uses and vegetation types provides numerous, diverse habitat types for a wide variety of plant and animal species. Several surveys have been conducted on the park's vegetation, including specific research for rare plant species and a baseline plant inventory which found 438 species of plants, more than 100 of which were non-native. The park has more than 500 documented plant species, and several have been designated as State-listed rare, threatened, or endangered by the Maryland Department of Natural Resources Wildlife and Heritage Service. Large wooded areas of the park contain species typical in the Eastern deciduous forest such as oaks (*Quercus*), hickories (*Carya*), maples (*Acer*), American beech (*Fagus grandifolia*), tulip poplar (*Liriodendron tulipifera*), and American sycamore (*Platanus occidentalis*). The battlefield also has several large diameter trees that may have existed around the time of the battle. These possible "witness" trees require special management and care due to their advanced age and importance in the historical context.

Wildlife - The diverse mix of vegetation, land use, and habitat types provides conditions suited to hosting a wide range of wildlife. The battlefield's proximity to suburban and developed areas of Frederick County, namely Urbana and the City of Frederick, make it an even more attractive sanctuary for native species. There are more than 20 species of mammals, over 100 species of birds, 18 species of reptiles and amphibians, and approximately 40 species of fish documented in the battlefield. While not all of these species are classified as breeding within the park, they all utilize park resources as habitat and forage. Of these species, several have been designated as State-listed rare, threatened, or endangered by the Maryland Department of Natural Resources Wildlife and Heritage Service or are listed as Partners in Flight Watch List or Stewardship Species.



left and center: Terra Rubra; right:: Worthington House, Monocacy National Battlefield

Cultural Resources

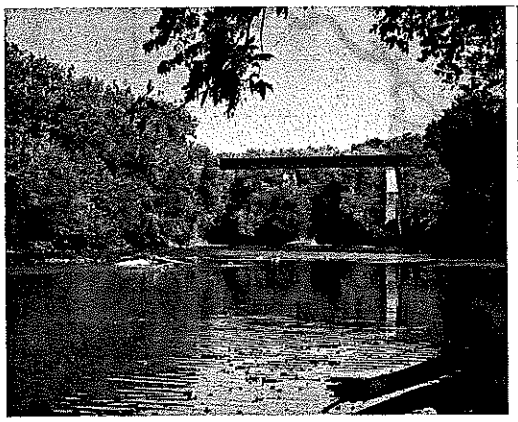
The battlefield contains many historic and prehistoric cultural resources which reflect the broad regional settlement trends. It contains numerous archaeological sites, historic structures, and cultural landscapes as well as a collection of museum objects and artifacts related to the site. The battlefield was listed on the National Register of Historic Places and designated a National Historic Landmark in 1973, and two of its resources are individually listed on the National Register as well – the Gambrill House (1985) and the Best Farm Slave Village (2008).

Archaeological Sites - Known prehistoric and historic archaeological sites at the battlefield are located on the Baker, Best, Thomas, and Worthington Farms as well as on the Gambrill tract. Eleven prehistoric sites date from the Early Archaic to the Late Woodland periods including both short-term base camps and lithic scatters. Nine historic archaeological sites have been identified, including the battlefield itself, two short-term Civil War encampments, a slave village associated with L'Hermitage, the Best Farm historic complex, the Middle Ford Ferry Tavern site, the Thomas Farm historic complex,

the Thomas Farm Blacksmith Shop, and the Worthington Farm historic complex.

Historic Structures - Fifty-two historic structures are located on the battlefield. The structures include those that existed during the battle as well as those that are not battle related but contribute to the significance of the cultural landscape. Structures range from eighteenth- and nineteenth-century houses and dependencies to twentieth century buildings related to the area's agricultural development.

Cultural Landscapes - A cultural landscape is an area with significant cultural and natural resources, associated with historic events or people, which helps us understand the evolution of human use of the site. The battlefield preserves a large historic landscape that is made up of several component landscapes, including the Hermitage (Best Farm), Araby (comprising the Gambrill Tract, Lewis Farm, and Thomas Farm), Clifton (Worthington Farm), and the Baker Farm. The battlefield's landscape still retains a high level of its historic character and integrity, even though it is increasingly pressured by outside development.



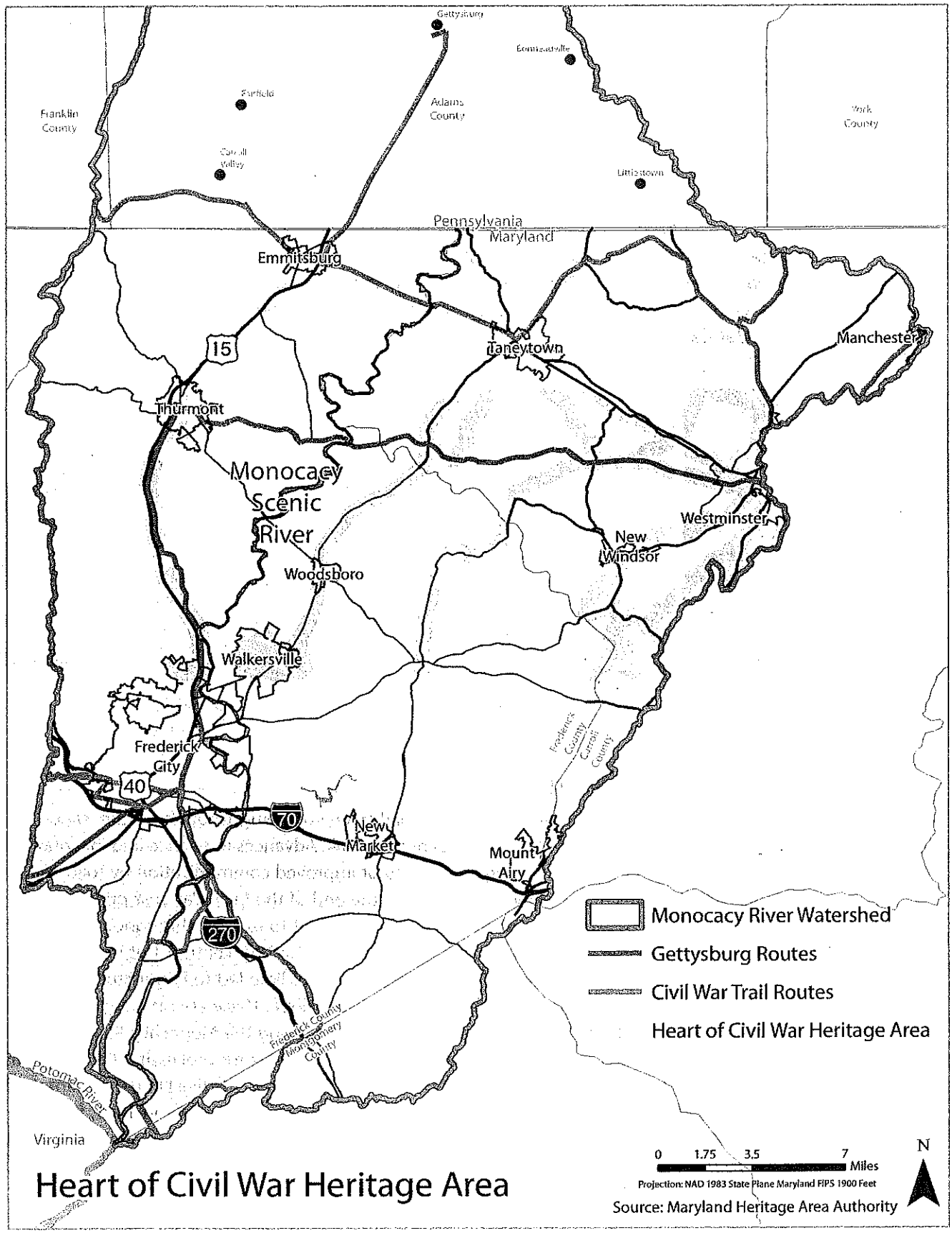
Railroad crossing over the Monocacy River, 0.5 miles north of the Potomac River

Monocacy Aqueduct

Sugarloaf Mountain

Industrial-Urban Dominance (1870-1945)

By the 1870's, the Industrial Revolution, which had been spreading throughout the nation since the first decades of the 19th century, had reached its peak. Advances in science and invention, the increase in population, and the consequent spread of improved communication by road, rail, and water, as well as by electricity, came together after the end of the Civil War. Just prior to the Civil War, the use of lime to fertilize agricultural fields was poised to expand throughout the County. Stone lime kilns on some farms had been in use since the early 19th century, but they were often single stacks and of small size. The commercial production of lime led to larger stone stacks and ranks of several kilns in a single structure backed against a slope. These are primarily found in the center of the County along the limestone deposits running along the Monocacy River Valley and in the Piedmont Uplands to the east. Manassas J. Grove built kilns for processing lime near Lime Kiln in about 1858 for his own use and, by 1875, had founded the M. J. Grove Lime Company. In the vicinity of Woodsboro, John Le Gore established the Le Gore Lime Company in 1861, followed in 1875 by S. W. Barrick & Sons on an adjoining tract. Individual farmers still raised their own smaller kilns and even sold lime to their neighbors in the period about 1870 to 1900, but the commercial lime producers soon became the principal sources of agricultural lime.


Gettysburg
Emmitsburg
Fairfield
Franklin County
Adams County
York County
Carroll Valley
Littlestown
Pennsylvania
Maryland
Emmitsburg
15
Taneytown
Manchester
Thurmont
Monocacy Scenic River
Westminster
New Windsor
Woodsboro
Walkersville
Frederick City
40
70
New Market
Mount Airy
270
Frederick County
Carroll County
Frederick County
Montgomery County
Potomac River
Virginia
Monocacy River Watershed
Gettysburg Routes
Civil War Trail Routes
Heart of Civil War Heritage Area
0 1.75 3.5 7 Miles
Projection: NAD 1983 State Plane Maryland FIPS 1900 Feet
Source: Maryland Heritage Area Authority
N
Heart of Civil War Heritage Area

Entering the 20th Century

After the Civil War, both Frederick and Carroll Counties recovered fairly quickly. This was partially because Maryland did not experience the more severe reconstruction efforts that were enacted elsewhere in the south.

Commerce and industry continued to grow during the late 19th and 20th centuries, but both were primarily dependent on the farming community. World War II helped to spur continued industrial development, and by the 1950's both counties were experiencing rapid growth and economic diversification. With the presence of the Federal government as a reliable economic engine, growth in the region has continued at a steady pace during the past four decades.

The remains of houses, a glassworks, lime kilns, grain mills and an ore pit are small indicators of many more sites from the period of colonial settlement that remain undiscovered. Documented sites along the Monocacy River, spanning the time period of the 18th, 19th, and 20th centuries, are somewhat representative of farming and the early industries that thrived in the area.

Significant Historic and Archaeological Sites

Increasing growth can threaten historical and archaeological resources in Carroll and Frederick Counties. Beginning in the 1960's Frederick County surveyed over 3,300 historic sites. The inventory was updated in the early 1970's and future updates are planned. In Carroll County, historic sites were surveyed during 1970 and 1971. Below are highlights of some archaeological and historic sites located along the Monocacy.

-
- The Monocacy National Battlefield is protected and managed by the National Park Service. It is a significant historic, scenic and cultural resource adjacent to the Monocacy River. (See Monocacy National Battlefield section above)
- The 10,000-acre Sugarloaf Mountain Historic District has numerous significant historic and archaeological sites. Early industrial activities included glass-making and lime and iron production. The mountain itself was designated a Natural Landmark by the United States Department of the Interior in 1969.
- The Monocacy Aqueduct, constructed from 1829-1863, is on the National Register. It crosses the Monocacy River and its considered to be one of the best examples of aqueduct engineering along the entire length of the C & O Canal. The structure was extensively restored in the early 2000's.
- The Baltimore and Ohio Railroad Viaduct (1870) was rebuilt in 1900; the viaduct is located about one half mile upriver from the Monocacy Aqueduct.
- By the late 18th century, there were over 870 grist mills in the Monocacy Valley. Michael's Mill was built in 1739 and operated until the 1950's. The mill is still standing. Another significant mill site on the river is Greenfield Mills which operated from the 1930's to the turn of the century. The Ceresville Flour Mill (south side MD 26) is an example of a prominent – and visible – mill structure that may not survive this generation intact without efforts to stabilize the building.

Complementary Preservation Efforts

Heart of the Civil War Heritage Area

In July 2006, the Heart of the Civil War Heritage Area (HCWHA) was designated a Certified Heritage Area under the Maryland Heritage Areas program - a combined tourism and economic development agency created by the State Assembly in 1996. This Heritage Area includes parts of Frederick, Washington, and Carroll Counties. Its focus is on the most dominant theme in tourism in the west-central region of Maryland—the Civil War. The HCWHA includes three battlefields—Monocacy, Antietam, and South Mountain—and lies directly along a heavily traveled tourist route between Gettysburg, Pennsylvania, and Harper's Ferry, West Virginia. In addition, numerous local organizations and museums already highlight the Civil War in all its facets, such as the National Museum of Civil War Medicine in Frederick. A partnership organization between the three Counties' elected officials, local historical groups, and museums, and the tourism offices of the counties form the local Advisory Committee. The program provides matching grants from dedicated state funds to encourage research, provide visitor facilities and improvements, protect historic properties with links to the Civil War theme through purchase or easement, and provide enhanced interpretation of the multiple stories linking the Civil War experience. There is no regulatory side to this designation, but more awareness of the need to protect fragile and irreplaceable assets of historical significance and economic value in the participating Counties is one of the intended goals of the program.

Maryland National Road Scenic Byway

In the early 2000's, the Old National Pike, which crosses the Monocacy River just east of the City of Frederick, was included in a grass-roots effort to nominate a National Scenic Byway. The result was the June 2002 designation of a six-state All-American Road, including the route in Maryland from Baltimore to the western state line with West Virginia and the section in Frederick County along MD 144, Old National Pike, and US 40 Alternate. This designation makes possible a grant program for interpretive programs and materials and easement acquisition, but institutes no regulatory responsibilities to any jurisdiction. A non-profit membership organization, the Maryland National Road Association, spearheads activities and promotions along the Historic National Road.

The following recommendations for the River jurisdictions are a compendium from the following sources:

- 1990 Monocacy Scenic River Study & Management Plan
- 2007 Frederick County Historic Preservation Plan
- 2010 Frederick County Comprehensive Plan

4-1) The Monocacy River has high potential for archaeological and cultural sites and their identificationshould not affect the rights of property owners

4-2) Increase public awareness and education about local cultural history and its relationship to the Monocacy River and its tributaries

4-3) Make focused efforts to voluntarily preserve remaining mill sites and mill structures along the Monocacy River

4-4) Continue to coordinate preservation planning with the Maryland Historical Trust, especially for proposed development that may impact historic and archaeological sites. This includes consideration to voluntarily protect sites of archaeological and historic significance, and the

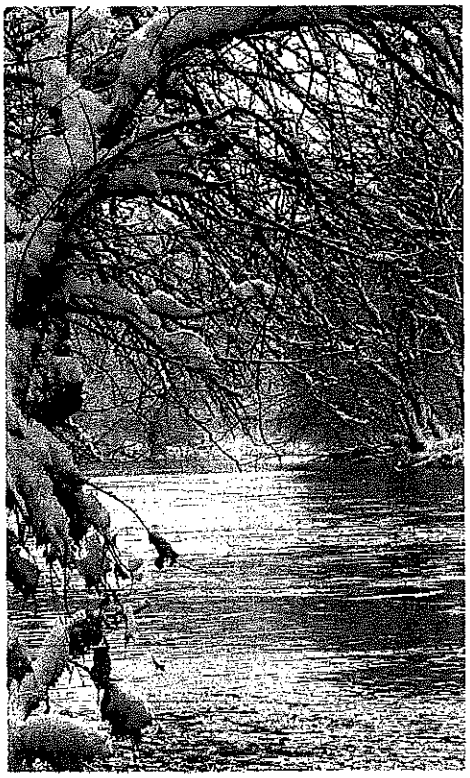
encouragement of land uses that may protect them

4-5) Continue active engagement with the National Park Service and involvement with their plans for the Monocacy National Battlefield. Coordination should address open space and recreational opportunities, future protection of a national historic property, public access to the Monocacy River, and how proposed development may benefit from proximity to important, archaeological and historic resources

4-6) When a significant historic site in the River corridor becomes available for sale, the counties should consider purchasing the site for the purposes of historic preservation and education or the promotion of adaptive reuse

[illegible] grows great when old men
[illegible] shade they shall never sit in.

Greek proverb



THE ECOLOGICAL ENVIRONMENT

During the first one hundred years of settlement (1700-1800), intensive land development and the consumption of other natural resources in the Monocacy watershed had altered the region's ecological character. Prior to European arrival, the Monocacy River Valley supported a rich and diverse variety of forest vegetation, wetlands, and wildlife.

The limestone regions had substantial forests that included Yellow Poplar, Beech, Red Oak, and Basswood. Silver Maple, Cottonwood, Sycamore, Ash, Elm, and Box Elder were abundant in flood plain forests. In the mountainous western region of the river basin, pine-oak-hickory forests were common, while the mountain hollows supported hemlock and mixed hardwoods (8). The American chestnut, once common in the Monocacy River Valley, was later eliminated by blight, which further contributed to change in forest cover. These woodlands, open grasslands, and wetlands supported a diversity of wildlife, including large herbivores such as elk and bison.

By the late 18th century, the Monocacy watershed's natural environment was indelibly altered. Thousands of acres of forests had been cleared for agriculture and prime hardwoods were harvested and processed into charcoal. These centuries of human-caused impact on forest, wetland, and other types of habitat have forced the decline or disappearance of many plant and animal species in the Monocacy Valley as well as the rest of the state.

Biodiversity in the Monocacy River Watershed

Over 1,200 native plants and animals in Maryland are identified by the Maryland Department of Natural Resources (DNR) as endangered, threatened, rare, or 'watch-list' species. Habitat loss, habitat degradation and fragmentation, and invasive species are widely considered to be among the greatest threats to the survival of Maryland's rare flora and fauna. However, some species are also vulnerable to and threatened by various human activities, especially illegal collection, over-exploitation, excessive harassment, excessive disturbance of their fragile habitats, and purposeful destruction.

In general, conservation of rare species is most effective when their habitats are protected. To facilitate habitat conservation, the locations of rare species were analyzed and processed using standardized methods by DNR into habitat conservation boundaries called Ecologically Significant Areas (ESAs). The ESAs are primarily the buffered habitat of rare, threatened, and endangered species, as well as significant or rare habitats and ecological systems. The ESAs are more generalized than exact focus points, which are only provided to data requesters under certain circumstances, such as landowners, scientists, researchers, and conservation partners, or to State permitting agencies during the review of development projects when habitat and locations may be impacted by the development. The ESAs do not function as a formal regulatory tool. There are no local codes or ordinances specifically addressing uses or activities within ESAs. Maryland DNR, when requested by local government agencies or landowners, will review development proposals and offer recommendations for mitigation if projects may impact habitat and areas within the ESAs.

Dickcessel

ESAs are area delineated by the Maryland DNR to identify where rare, threatened, or engaged plant and animal species and habitats may be present. ESA are only a generalized indication of where significant plant and animal habitat may be located and are not used in any type of regulatory means either by the Counties or the State. The River Board recommends that ESAs never be used as a regulatory tool.

Red Headed Woodpecker

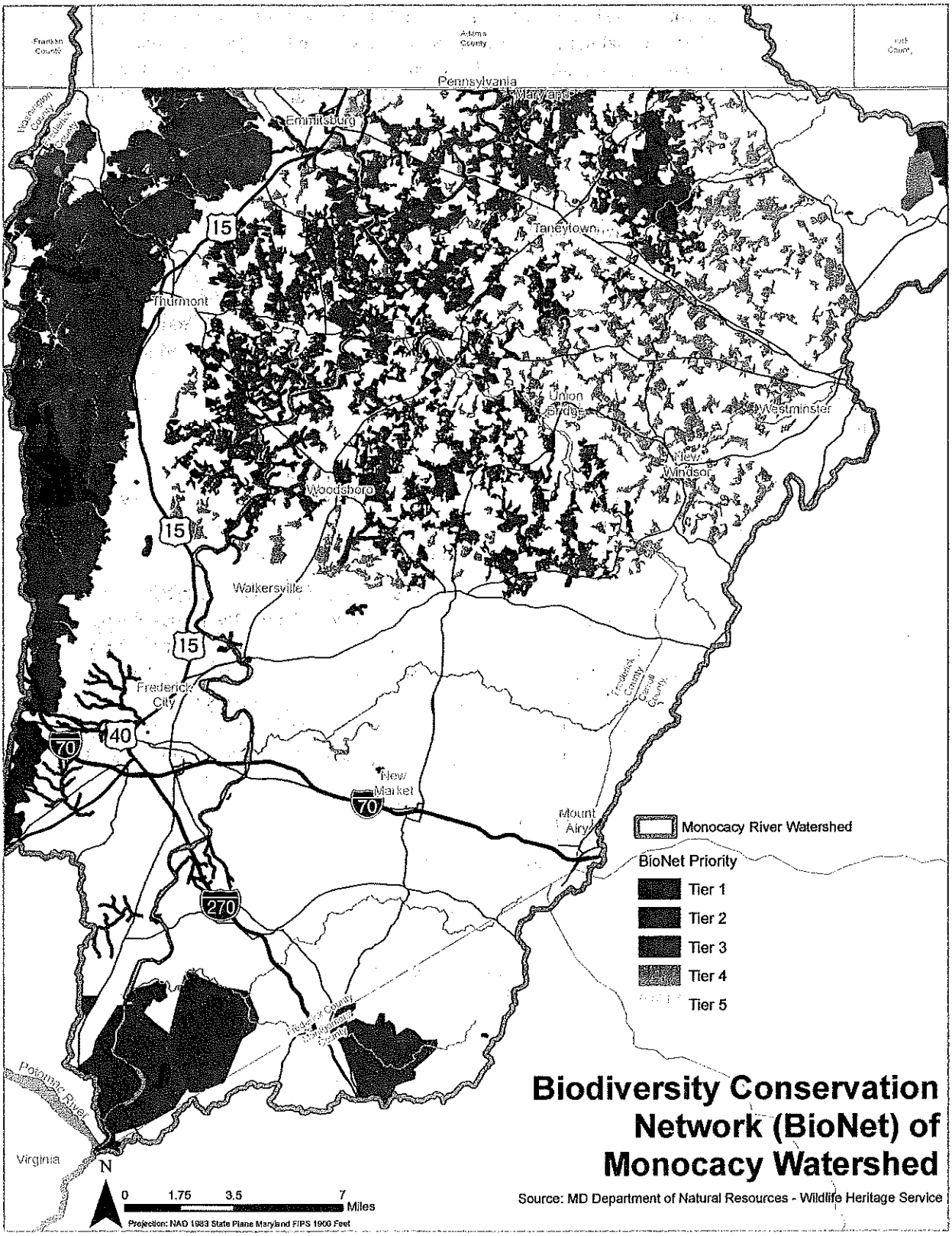
The Wildlife and Heritage Service of the Maryland Department of Natural Resources (DNR-WHP) produces maps and other products that integrate its vast data and prioritizes Maryland's vanishing natural landscape to highlight those areas that are important to conserve the full complement of species and natural communities currently found within the State.

Grasshopper Sparrow

The Biodiversity Conservation Network (BioNet) is a digital map that prioritizes areas for terrestrial and freshwater biodiversity conservation. It was developed by DNR to use for proactive land conservation activities, such as targeting for acquisitions and easements, location appropriate areas for project mitigation or habitat restoration, and planning for areas that require management to sustain dwindling species and habitats. In addition to focusing on vanishing species and habitats, and on high quality common habitats, the criteria used in BioNet also were designed to incorporate the large landscape required for migratory animals, population dispersal, and habitat shifts results from climate change.

In summary, BioNet includes and prioritizes:

- Only known occurrences of species and habitats
- Globally rare species and habitats
- Animals of Greatest Conservation Need
- Watch List plants and indicators of high quality habitats
- Animal assemblages (e.g., forest interior species)
- Hotspots for rare species and habitats
- Intact watersheds
- Wildlife and concentration areas


Pennsylvania
Maryland
Emmitsburg
Taneytown
Thurmont
Union Bridge
Westminster
New Windsor
Woodsboro
Walkersville
Frederick City
New Market
Mount Airy
15
70
40
270
Monocacy River Watershed
BioNet Priority
Tier 1
Tier 2
Tier 3
Tier 4
Tier 5
Virginia
N
0 1.75 3.5 7
Miles
Projection: NAD 1983 State Plane Maryland FIPS 1900 Feet
Biodiversity Conservation Network (BioNet) of Monocacy Watershed
Source: MD Department of Natural Resources - Wildlife Heritage Service

These areas are prioritized into a five-tiered system, as shown on BioNet map of the Monocacy River Watershed:

Tier 1: Critically Significant for Biodiversity Conservation
Tier 2: Extremely Significant for Biodiversity Conservation
Tier 3: Highly Significant for Biodiversity Conservation
Tier 4: Moderately Significant for Biodiversity Conservation
Tier 5: Significant for Biodiversity Conservation

According to the DNR-WHP, this five-tiered system was designed to capture and support the full array of biological diversity within Maryland, not just those places that are one of a kind, but also the places that are needed to maintain viable populations of more common species, and to maintain the larger fabric of our natural landscape.

The Monocacy River is biologically rich and diverse, as indicated by biological 'hot spots' that contain rare, threatened, or endangered species of plants and animals and their associated habitats. These lands are critical and vital to our region's biodiversity.

Monocacy Grasslands Important Bird Area (IBA)

IBAs are sites that support significant populations of birds considered vulnerable to decline and extinction. Sites are identified based on rigorous scientific criteria that focus on three categories of vulnerable birds.

1) At-risk species of conservation priority.
2) Species assemblages that specialize in a particular habitat type.
3) Birds that occur in exceptional concentrations.

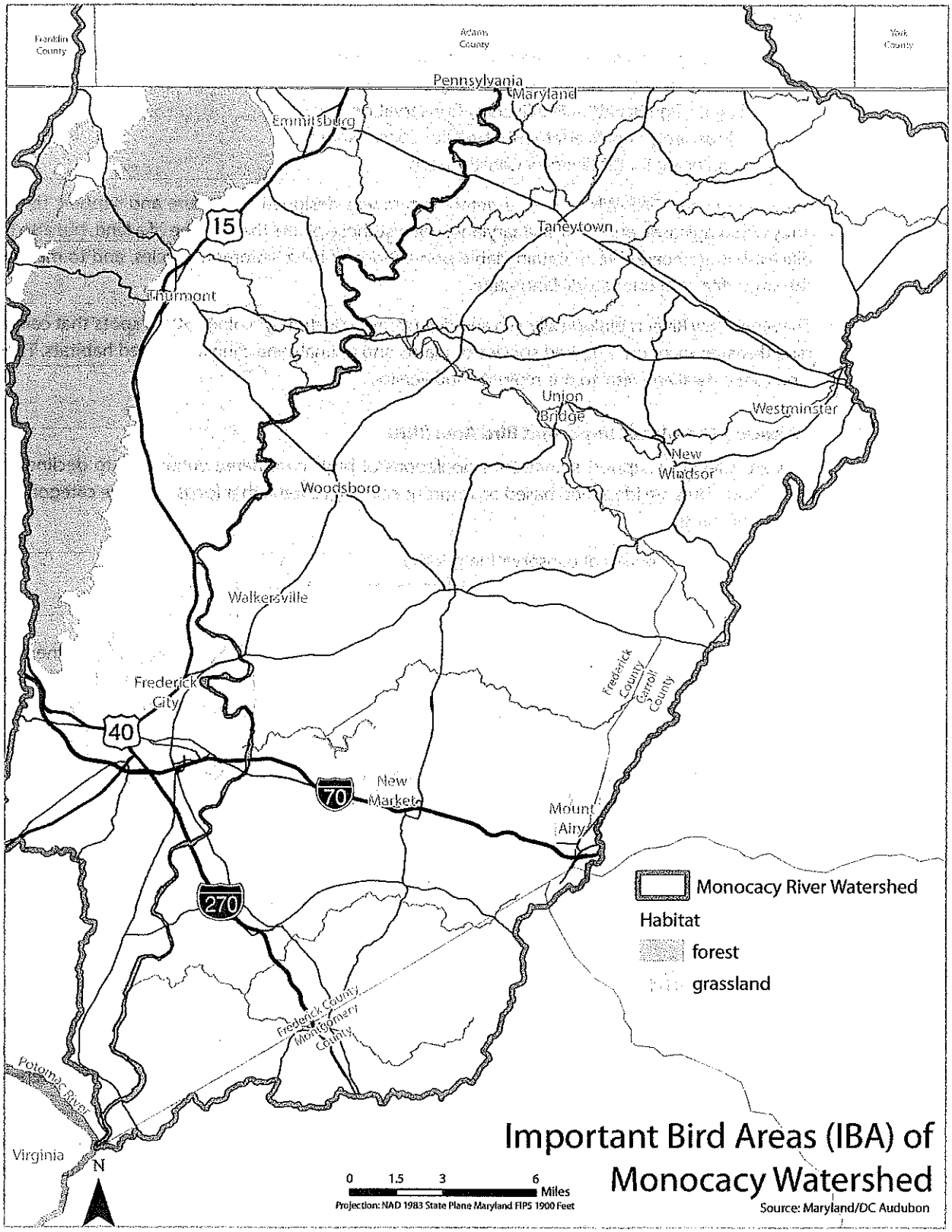
The IBA program began in the 1980s and seeks to achieve conservative goals through partnerships with conservation planners, landowners, and managers of public lands. IBAs are identified by an IBA Technical Review Committee, which reviews all nominated sites against scientific criteria based on analysis of bird populations and their habitats.

The Monocacy Grasslands was identified as an IBA in 2009 based on surveys of large populations of three at-risk bird species, Red-headed Woodpecker, Grasshopper Sparrow, and Dickcissel, as well as habitat supporting a highly diverse assemblage of grassland birds. This extensive IBA includes grasslands between U.S. Route 15 in Frederick County and MD Route 97 in Carroll County. More specific information on IBAs may be found at http://mddc.audubon.org/birds-science-education/important-bird-areas.

Riparian Forests

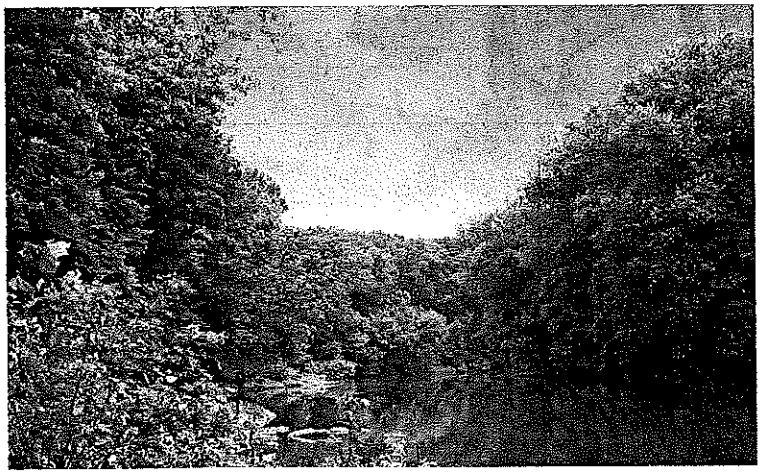
The Monocacy River's riparian environment includes forested floodplains and wetlands, vernal pools, forested slopes, non-floodplain forestlands, as well as cleared and cultivated agricultural fields. All have value, but a forested riparian landscape provides far superior environmental benefits or ecosystem services than a non-forested riparian landscape.

- Dense rows of trees growing in portions of the Monocacy's floodplain and riparian areas—sycamores, alder, red maple, oaks, etc.—provide nesting sites for bald eagles, blue heron rookeries, and many other birds, animals, and waterfowl. The Monocacy's floodplain and


Franklin County
Adams County
York County
Pennsylvania
Maryland
Emmitsburg
15
Taneytown
Thurmont
Union Bridge
Westminster
New Windsor
Woodsboro
Walkersville
Frederick City
40
70
New Market
Mount Airy
270
Frederick County
Carroll County
Frederick County
Montgomery County
Potomac River
Virginia
N
0 1.5 3 6 Miles
Projection: NAD 1983 State Plane Maryland FIPS 1900 Feet
Monocacy River Watershed
Habitat
forest
grassland
Important Bird Areas (IBA) of Monocacy Watershed
Source: Maryland/DC Audubon

riparian areas that lack woody vegetation reduce wildlife habitat, water quality benefits, and overall River resiliency.

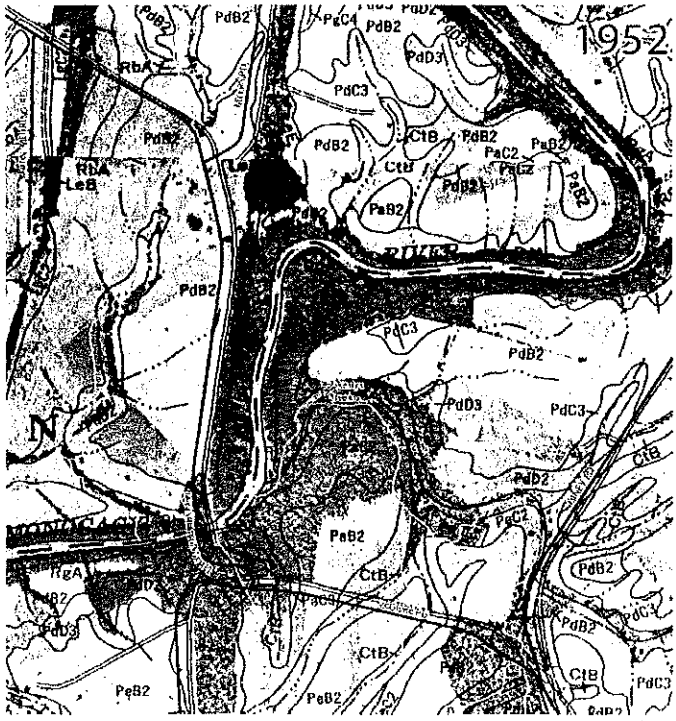
- Forested riparian areas and wetland areas are valuable for keeping soil intact during flooding events. Tree roots tightly hold and bind soil and control scour erosion, compared to plowed fields that lack woody structure. Rain falling on trees is intercepted and slowed by leaves, limbs, and branches, is utilized by tree roots, and infiltrated into the ground. To maintain maximum effectiveness, buffer integrity should be protected against soil compaction, loss of vegetation, and stream incision (Mayer 2006).
- The duff layer—fallen and decomposing leaves, twigs, bark, seeds, nuts, logs— in a forested riparian landscape sequesters sediment from overland flow and during flood events, preventing sediment from entering or reentering the river.
- Tree canopies provide shade which cools the surrounding area and is critical in moderating water temperatures, particularly in small streams.
- A riparian forest or floodplain forest is superior in its retention, detention, and interception of water from storm events and flooding, compared to agricultural fields or pasture that lack forest cover along waterways. Riparian and floodplain forests absorb energy from flood waters and help prevent otherwise higher downstream water levels during storm events and flooding, acting as natural flood protection for structures and people. Forests purify the very air we breathe.
- Riparian forests help to buffer and protect waterways by enabling bacterial transformation of the nutrient nitrogen (which in high amounts can pollute waterways) to harmless gas before it enters surface waters through overland flow (runoff), subsurface flow, or shallow groundwater flow. Cultivated fields or pasture lands adjacent to streams and rivers without vegetative buffers or stream fencing can also contribute soil-bound phosphorus directly to waterways through overland flow—runoff. These roles are critical for reducing loads to the rivers and meeting the federal mandated TMDLs.

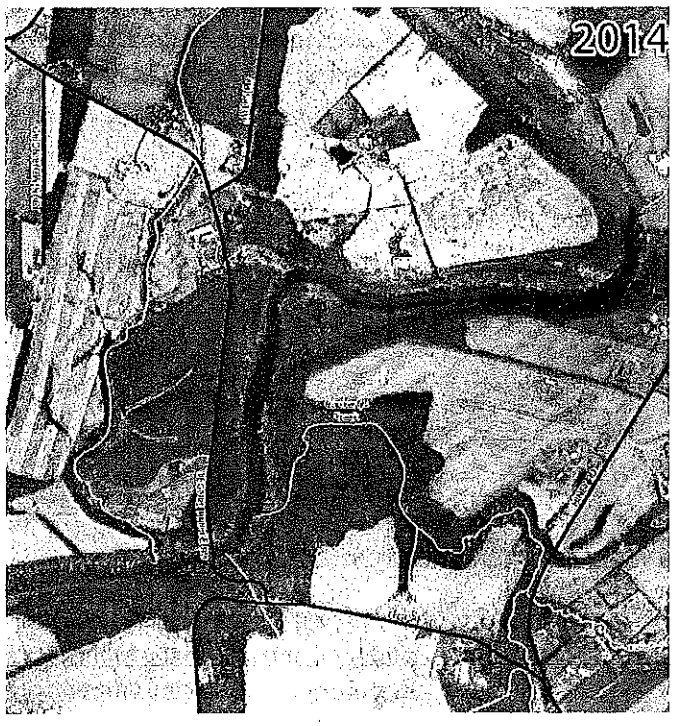


In the past 25 years, increased deer populations and invasive species have intensified and have profound impacts on the Monocacy River and the entire watershed. Increased deer densities result in more grazing and consumption of most young tree seedlings—saplings—which severely reduces natural forest regrowth, regeneration, and succession.

Notice how the forest cover along the west side of the River has increased in this area in southern Frederick County, providing additional habitat, water quality protection, and enhancement of the River.

The natural landscape in the Legore Bridge area of Frederick County looks nearly identical today as it did in 1952 as shown on this historical USDA soil map.



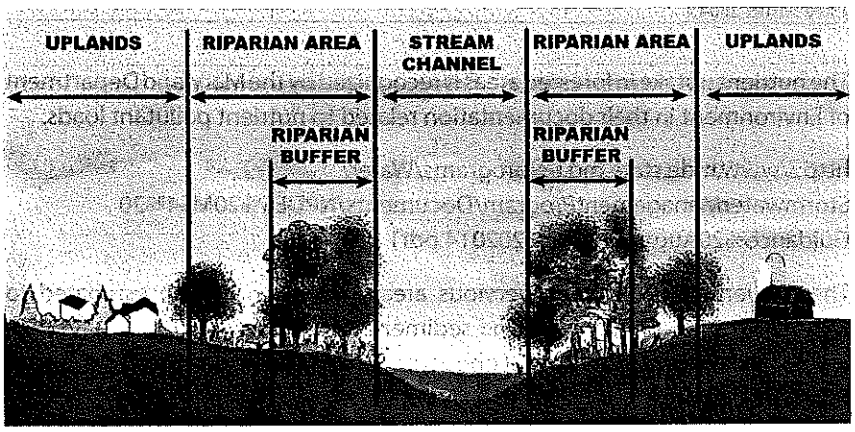


Various examples of riparian buffers

Today, woody invasive plants, such as Ailanthus ('Tree of Heaven'), Bradford Pear, Norway Maple, Autumn and Russian olive, Bush Honeysuckle, Japanese Barberry, Multifora Rose, Japanese Bittersweet, Garlic Mustard, and Oriental Stiltgrass have seen significant spread through the entire watershed. These invasives can quickly overtake an area, significantly affect the food web, and displace native vegetation. Non-native invasive plants and trees prevent natural forest regeneration and ecological succession In many cases, they negatively alter soil chemistry and nutrient cycling, as well as reduce wildlife habitat since they do not provide the high quality food and cover that native vegetation provides. Once invasive communities become established, they tend to remain in place unless control measures are initiated.

Riparian Forest Buffer Research

Simpson and Weammert (2009) define a riparian forest buffer as "an area of trees, usually accompanied by shrubs and other vegetation, that is adjacent to a body of water which is managed to maintain the integrity of streams and shoreline, to reduce the impacts of upland sources of pollution by trapping filtering, and converting sediments, nutrients, and other chemicals, to supply food, cover, and thermal protection to fish and other wildlife."



www.mychamplain.net

Sugarloaf Mountain

Riparian, or streamside, areas are important and sensitive components of the landscape because they are the transition area between the terrestrial (uplands) and the aquatic environment. Riparian forests provide a critical ecological environment where biological processes can flourish and provide nesting, movement, and shelter habitat for mammals, birds, amphibians, and reptiles. They also provide an essential mechanism for the improvement of water quality. Surface runoff, shallow groundwater flows, and subsurface flows interact and pass through unique soil and vegetation types to provide uptake and transformation of nutrients. This process has been extensively researched and documented along with the ecological benefits to temperature control, bank stability, erosion control, and leaf and limb litter for habitat and food.

Recommended riparian buffer widths in the scientific literature vary greatly

Monocacy Natural Resource Management Area

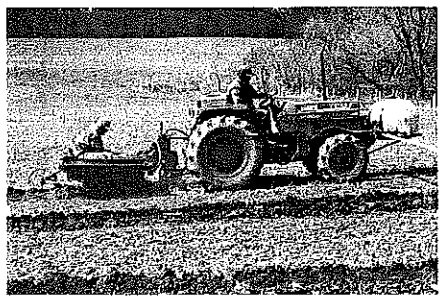
depending on the resource being protected (e.g., forestlands, habitat) or environmental function being addressed (e.g., flood attenuation, nutrient cycling). Landscape features such as slope, soil type, vegetation mix, and impervious surfaces can impact the effectiveness of riparian buffers.

Most research supports effective buffer width for water quality in the 50-150 foot (15- 45 m) range (Belt, 2014). Areas with steep topographical gradients in a forested condition adjacent to the Monocacy River may require enhanced buffer management. A high potential exists for direct water quality impacts to the Monocacy River, caused by sedimentation, if wooded slopes adjacent to the River are cleared and converted to other uses.

Hawes and Smith (2005) summarized effective buffer widths from their review of 4 riparian buffer studies:

	Effective Width of Buffer (in feet)							
Author	**Aquatic Wildlife**	**Terrestrial Wildlife**	**Stream Temperature**	**Litter/Debris input**	**Nutrient Retention**	**Sediment Control**	**Bank Stabilization**	**Pesticide Retention**
Wenger 1999		220-574 ft.	33 – 98 ft.	50 ft.	50 – 100 ft.	82 – 328 ft.	–	> 49 ft.
Army Corps 1991	98 ft.	30 – 656 ft.	33 – 66 ft.	66-102 ft.	52 – 164 ft.	33 – 148 ft.	49 – 98 ft.	49 – 328 ft.
Fisher and Fischenich 2000	> 98 ft.	98-1,640 ft.	–	10 – 33 ft.	16.4-98 ft.	30-200 ft.	30 -66 ft.	–
Broadmeadow and Nisbet 2004	33 –164 ft.	–	49 – 230 ft.	82 – 328 ft.	16.4-98 ft.	49 – 213 ft.	–	–

DNR Foresters at work in the MNRMA.



The nutrient uptake in forested areas is recognized by the Maryland Department of Environment in their documentation related to nutrient pollutant loads.

http://www.mde.state.md.us/programs/Water/StormwaterManagementProgram/Documents/NPDES%20MS4%20Guidance%20August%2018%202014.pdf)

The conversion of urban impervious area to forest has been estimated to reduce nitrogen, phosphorus, and sediment pollution by 71%, 94%, and 93% respectively. MDE estimates that one acre of urban impervious area contributes 10.85 pounds of nitrogen to local waterways per year. That is compared to one acre of forest, which contributes 3.16 pounds of nitrogen per year.

While water quality protection is one objective of riparian buffers, there are additional environmental benefits derived from buffers greater than 150 feet.

The minimum recommended width of riparian buffer strips from most studies of avian populations is 100 meters (300 feet) (Fisher 2001). Other studies addressing ecological concerns associated with riparian buffer strips also tend to provide recommendations for buffer strips far in excess of what is typically recommended for water quality (Fisher 2001). Forested areas as wide as 600 feet have been recommended where there are heron rookeries, bald eagles, or cavity-nesting birds (USDA Natural Resources Conservation Service 1996c).

Perhaps the best known reason for protection of streamside areas is their importance for wildlife and wildlife habitat (Ellis 2008). Drawing from conclusions of 6 scientific studies on wildlife, wildlife habitat, and stream

Table 1. A summary of the specific conclusions and recommendations of six publications on the size of vegetated buffers needed for wildlife and wildlife habitat protection. All authors emphasized that different species of wildlife require different vegetated buffer widths.

Ellis and Richards 2008	"While narrow buffers offer habitat benefits to many species, most wildlife—especially birds and larger mammals—depend upon riparian areas that are a minimum of 300 feet wide."
Fischer 2000	"If avian habitat is a management objective, managers should consider managing for riparian zones that are at least 100 m [328 feet] wide."
Fischer et al 2000	"Recommended widths for ecological concerns in buffer strips typically are much wider than those recommended for water quality concerns, often exceeding 100 m [328 feet] in width. These recommendations usually apply to either side of the channel in larger river systems and to total width along smaller streams where the canopy is continuous across the channel."
	"Management for long, continuous buffer strips rather than fragments of greater width should also be an important consideration."
Knutson and Naef 1997	The mean width of all wildlife studies reviewed indicate that 88 meters (287 feet) is required to protect wildlife habitat.
Schwab 2002	"Our research shows the average minimum distance between [bat] roost sites and perennial water to be 90 meters [295 feet]."
Wenger 1999	"While narrow buffers offer considerable habitat benefits to many species, protecting diverse terrestrial riparian wildlife communities requires some buffers of at least 100 m (~300 ft)."
	"[H]owever, 300 ft wide buffers are not practical on all streams in most areas. Therefore, minimum riparian buffer width should be based on water quality and aquatic habitat functions. . . . In addition, at least a few wide (300–1000 ft/~90–300 m) riparian corridors and large blocks of upland forest should be identified and targeted for preservation."

vegetated buffers, Ellis (2008) reports that to protect wildlife and habitat, 300 foot stream buffers be maintained. The conclusions and recommendations by these 6 authors listed in Ellis (2008) are shown below:

A summary of 83 studies conducted on the size of riparian vegetated buffers needed to protect wildlife and wildlife habitat from Ellis (2008) are included in the Appendix of this Plan.

While there is benefit to creating new riparian buffers and these endeavors are certainly encouraged, it is thought that using ordinances to protect existing buffers will likely be cheaper than creating new buffers or restoring degraded ones (Mayer et. al., 2005). For maximum and long-term effectiveness, buffer integrity should be protected against: a) soil compaction from vehicles, livestock, and impervious surfaces (e.g., pavement) that might inhibit infiltration or disrupt water flow patterns (Dillaha et al. 1989; NRC 2002), b) excessive leaf litter removal or alteration of the natural plant community, and c) urbanization and other practices that might disconnect the stream channel from the floodplain and thereby reduce the spatial and temporal extent of soil saturation (Paul and Meyer 2001, Groffman et al., 2003, Groffman et al. 2005).

Most local buffer criteria are composed of a single requirement that the buffer be a fixed and uniform width from the stream channel. Others are variable taking into consideration bank slopes and the presence of wetland features. Urban stream buffers range from 20 to 200 feet in width on each side of the stream according to a national survey of 36 local buffer programs, with a median of 100 feet (Heraty, 1993). Most jurisdictions arrived at their buffer width requirement by borrowing other state and local criteria, local experience, and, finally, through political compromise during the buffer adoption process. Most communities require that the buffer fully incorporate all lands within the 100-year floodplain, and others may extend the buffer to pick up adjacent wetlands, steep slopes or critical habitat areas (Excerpts from Article no. 39 in The Practice of Watershed Protection, Scheuler, T.R. and H.K. Holland, Eds. 2000. Center for Watershed Protection, Ellicott City, MD).

Voluntary reforestation of critical gaps in the Monocacy River's riparian environment will enhance its scenic

qualities, support wildlife habitat, and improve overall ecological function of the Scenic Monocacy River.

Local Efforts

Since the late 1980's renewed efforts have been made in the Monocacy River Watershed, through federal and state Chesapeake Bay Watershed programs, to enhance water quality and stream health by planting trees and shrubs adjacent to waterways, creating permanent forest conservation easements, implementing enhanced Best Management Practices (BMPs) on agricultural lands, creating networks of like-minded conservation groups, and educating the public on the benefits of forestlands on clean water, meeting mandated load reductions, and a healthy Chesapeake Bay.

Through these programs, Monocacy River Watershed Foresters from the Maryland Department of Natural Resources also targeted the 1,800-acre Monocacy Natural Resource Management Area (MNRMA) for restoration, tree planting, and research. The MNRMA is a publicly-owned natural area adjacent to the Monocacy River and Sugarloaf Mountain in southern Frederick County and contains vast forestlands, fields, and agricultural uses, providing abundant wildlife habitat and ecosystem preservation.

Nearly 300 acres of forest plantings and warm-season grass meadows have been established at MNRMA by the State of Maryland. A comprehensive stewardship plan

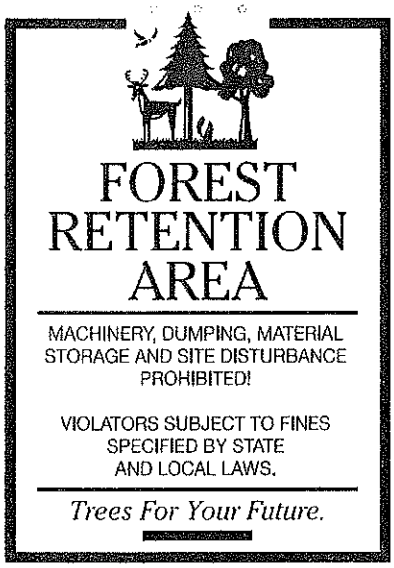
Forest Conservation

Recognizing the importance of trees and forests to Maryland's waters, landscape and residents, the Maryland Legislature enacted the Forest Conservation Act of 1991 (FCA) to help protect and enhance forest resources in Maryland. Acknowledging that land development and conversions have impacted Maryland's forestlands and wildlife habitat, the FCA applies to all counties in Maryland with less than 200,000 acres of forest; Garrett and Allegany Counties are exempt from the FCA.

Generally, land development projects that are equal to or greater than 40,000 square feet (0.92 acres) are subject to the FCA. In order to fairly distribute forest stewardship responsibilities, the FCA encompasses two 'quantitative goals.' The first is to replace a certain amount of forest that is removed as part of the development process, called Reforestation or Conservation. The other goal is Afforestation, which requires applicants to plant forest in accordance with the 'afforestation threshold,' which is 20% of the development site. This means that if the amount of forest on a site is less than 20%, the applicant is required to plant up to 20% of the development site in forest.

The FCA prioritizes the types of environments to be preserved and planted. Essentially, the highest priority sites are those that are hydrologically sensitive. These include: streams, rivers, wetlands, springs, etc. The reason that hydrologically sensitive areas are specified as priority sites is that forest cover in these areas help to absorb excess nutrients before they enter aquatic systems, and forest cover stabilizes soil in sensitive areas, thereby reducing erosion and sedimentation of our waterways. Other areas of priority for forest retention or planting are: habitats of rare, threatened, or endangered species; areas which connect large blocks of forested tracts ('hubs') that facilitate wildlife movement; areas containing specimen tree species; forest areas that are parts of historic landscapes, or forests that buffer incompatible land uses.

As of July 2015, a total 6,892 acres of forestland has been permanently protected through the FCA in Frederick County (this figure includes land outside of the Monocacy River Watershed). In Carroll County, 1,199 acres of forestland has been protected through the FCA within the Monocacy River Watershed.



has been developed for the property that addresses development of old growth forests, some rotational timber harvesting, invasive plant control, and Agroforestry initiatives (the intentional blending of trees and shrubs into crop and livestock systems). Other research and demonstration activities developed at MNRMA include:

- Buffer demonstration areas
- Cattle fencing plots
- Tree growth field investigations
- Mice and vole control studies
- Tree shelter, deer fencing experiments

Forest Legacy

The US Congress created the Forest Legacy Program in 1978, which allows public acquisition of forest lands and compensation to landowners for "protecting, managing, and enhancing the productivity of timber, fish, and wildlife habitat, water quality, wetlands, recreational resources, and aesthetic values of forest lands...and investing in practices to maintain, protect, and enhance forest resources..." (16 US Code § S2103a). The Maryland Forest Service within the Department of Natural Resources (MD-DNR) is the agency designated to implement the Forest Legacy Program in Maryland (11).

The MD-DNR conducted a Forest Legacy Assessment of Need in 1995, with an update completed in 2007 that focused on the incorporation of socioeconomic factors such as recreational forest values, location of productive timber stands, and indicators for forest area vulnerability. The 2007 Assessment defined strategic forests as key blocks of forest providing the optimal mix of ecological and socioeconomic values necessary to support natural resource-based industries and to maximize ecological benefits (11). These efforts by the State utilized Maryland's 2000 Green Infrastructure Assessment, a comprehensive inventory of ecologically significant lands in the State.

Although only a portion of the Monocacy River Watershed was included in the State's Forest Legacy Assessment, it is important to note that the 2007 Assessment includes those portions of the Monocacy River Watershed containing all the River's headwater streams that originate on the eastern slopes of the Catoctin Mountain range, north of the City of Frederick. These forested headwater streams within the Catoctin Mountains support native brook trout, which require cool water temperatures that forests provide.

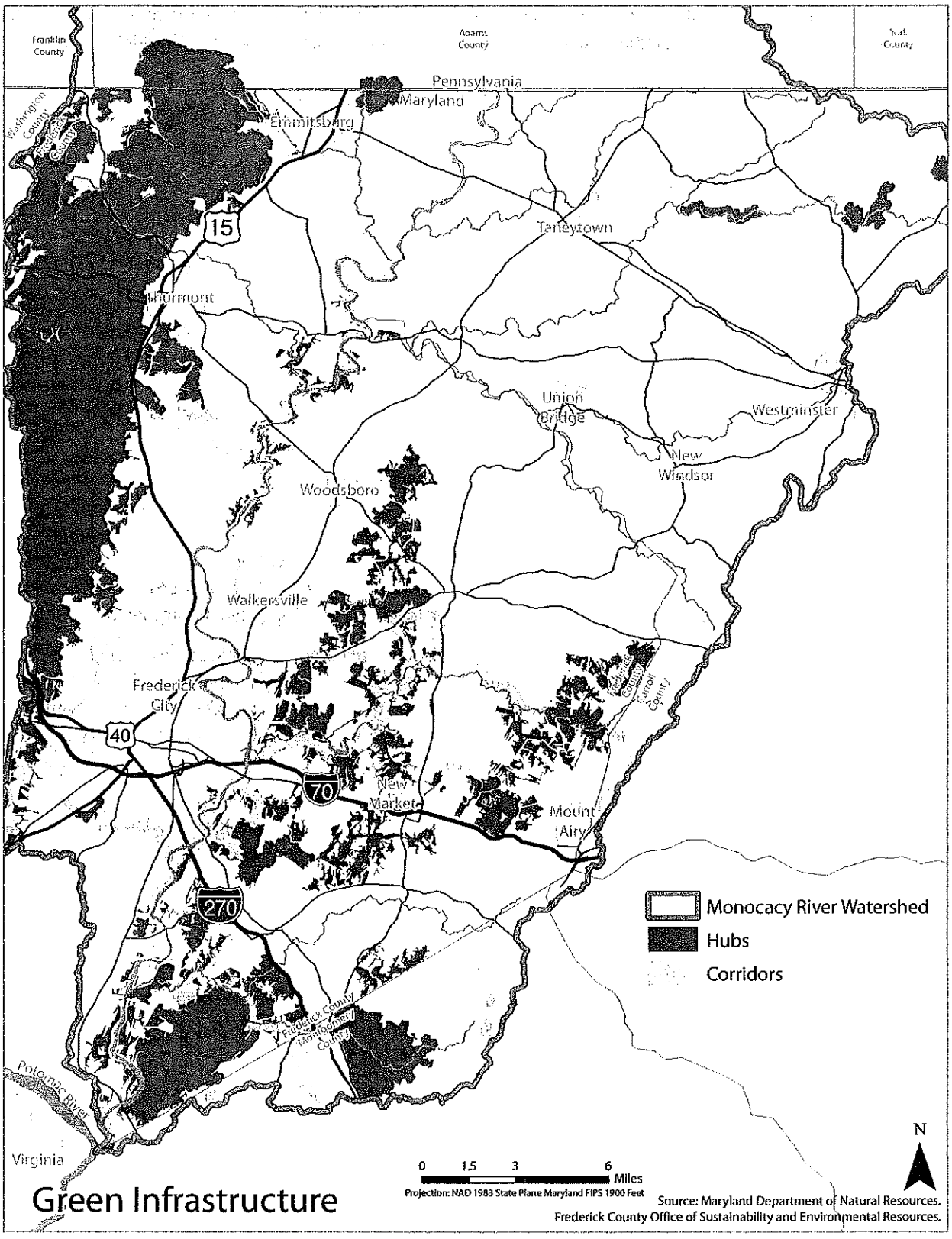
Since that time, Frederick County has created its own Green Infrastructure analysis to identify a local network of significant environmental landscapes, which includes the forestlands present along the Monocacy River. Given the critical importance of the Monocacy Scenic River's forestlands for water quality protection, TMDL requirements, and wildlife habitat, additional focus on the forest resources along the River is needed.

A Ribbon of Green

The Monocacy River and its riparian forests can be viewed as a unified, cohesive, inseparable whole, a "functional unit" as used to describe an ecosystem. The Monocacy River Corridor is part of our 'Green Infrastructure'.

Green Infrastructure is a network of 'hubs' (large, unfragmented forested areas) and connections (linking the hubs) that allows animals, seeds, and pollen to move and migrate from one area to another. They also protect the health of river and streams by maintaining adjacent vegetation to trap nutrients and sediment.

Large portions of the Monocacy River's forestlands are included as GI hubs in the County, where significant forestlands and wetlands areas are adjacent to the River as shown on the accompanying maps. The River and its forests can be viewed as a linear natural resource throughout the County, providing longitudinal connectivity of habitats, species, and natural communities between up-River and down-River areas.


Franklin County
Adams County
Pennsylvania
Maryland
Washington County
Frederick County
Emmitsburg
15
Taneytown
Thurmont
Union Bridge
Westminster
New Windsor
Woodsboro
Walkersville
Frederick City
Carroll County
40
70
New Market
Mount Airy
270
Monocacy River Watershed
Hubs
Corridors
Montgomery County
Potomac River
Virginia
0 1.5 3 6 Miles
Projection: NAD 1983 State Plane Maryland FIPS 1900 Feet
N
Green Infrastructure
Source: Maryland Department of Natural Resources.
Frederick County Office of Sustainability and Environmental Resources.

Both Frederick County and the State of Maryland have performed Green Infrastructure analyses to identify key forest hubs, their resources and functions, as well as the connections for linking hubs. The hubs and connections identified by the State were expanded using Frederick County-specific forest data, wetland studies, geo-spatial analysis, and other established County priorities and goals. Gaps in the local Green Infrastructure network were evaluated through a landscape-ecology restoration opportunity matrix, which examined, for example, lands along the River with hydric soils or floodplain that lack forest cover, and agricultural fields surrounded by forest.

Ecosystem Services

When land that contains forests and wetlands is developed into human-centered uses, there are costs incurred that are typically not accounted for in the marketplace; they are hidden costs to society. These services, such as cleansing the air, capturing nutrients and sediments, and filtering water, are fundamental needs for humans and other species, but in the past, the lands providing them have been so plentiful and resilient, that they have been largely taken for granted. In the face of a tremendous rise in both population and rate of land conversion, many people now realize that these natural or ecosystem services must be afforded greater consideration. (13)

The Maryland Department of Natural Resources is currently creating an "Ecosystem Service Valuation Framework" that will establish metrics for communities to use when considering land use planning decisions and development projects. The Framework evaluates natural assets using valuation and economic analysis that put a monetary value on the activities, functions, and opportunities that conserved lands offer, such as ground and surface water filtration, water supply and flood protection, and recreational opportunities. Like a return on investment, the Framework uses nature as a portfolio for what it provides—a "return on environment". US Government agencies that manage land must now take into account ecosystem services when writing management plans or evaluating proposals for activities or development, according to Elliott Campbell of the Maryland Department of Natural Resources.

Consider the billions of dollars spent each year to construct or maintain Maryland's built ('grey') infrastructure of roads, bridges, buildings, and utilities that we depend on for modern life. By contrast, the amount of money we collectively spend as a society to preserve and protect our Green Infrastructure—our natural life support system—is an order of magnitude less.

Fish and Wildlife

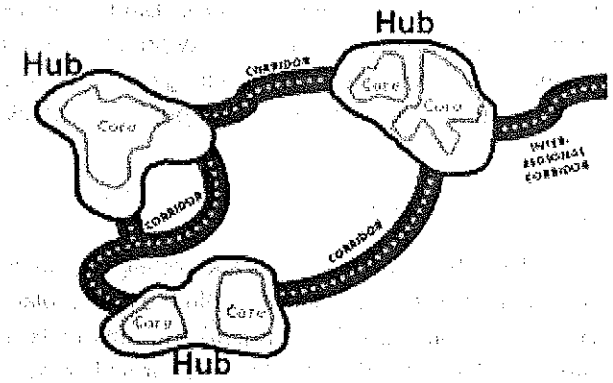
Stream valleys are important to fish and wildlife for several reasons. They provide vital sources of food, and habitat for breeding and serve as migratory routes for some animals. As development continues in the watershed, the Monocacy's stream valleys will play an even more critical role in the survival of plants, animals, and maintenance of water quality.

Removal of forest cover in the watershed has disrupted the ecological balance between natural habitat and living resources. Agriculture and development have changed the natural patterns of plant succession. Farming practices with unfettered livestock access to waterways and streams that lack sufficient vegetated buffers result in elevated water temperatures (harmful to fish and aquatic organisms) and excessive sediment and nutrient inputs to stream systems, and eventually to the Monocacy River. Compared to pre-European settlement, wildlife habitats now restricted to farmland, isolated woodlots, streams, and certain protected public lands, limit the diversity and reproductive capacity of plant and animal species that remain in the areas.

Information gleaned from fish and wildlife surveys is partially indicative of the Monocacy's ecological health. A river that has poor to fair water quality may only support a marginal number of different species. Some species, such as catfish and carp, can better survive in polluted waters, further disrupting the ecological balance. The

Monocacy River has the potential to support a greater diversity of fish and wildlife populations as efforts continue to improve its water quality.

From Green Infrastructure by McMahon & Benedict, 2006



Fish Species

The Department of Natural Resources, Inland Fisheries Division documented a total of 39 fish species representing ten families in the Monocacy River between 2006 and 2013. The sunfish family (*Centrarchidae*) contained the most abundant recreational species that included Smallmouth Bass, Redbreast Sunfish, Rockbass, and Longear Sunfish. Although they are caught throughout the Monocacy, Largemouth Bass are not considered to be abundant, except in the impounded habitat upstream of Starners Dam in the northern watershed. There was little difference in species richness between the upper and lower river segments (see Table 1, "Fish Species collected from Monocacy River" in Appendix).

The minnow family (*Cyprinidae*) contains the most abundant nongame fish species. Spotfin Shiner, Bluntnose Minnow, and Spottail Shiners are the most abundant minnows and provide food for the predatory game fish species. Common Shiner, Swallowtail Shiner, and Fallfish are also abundant throughout the Monocacy. The largest member of the minnow family, the Common Carp, is commonly found throughout inhabiting the slower, deeper pools.

The Northern Hog Sucker along with the Shorthead Redhorse, Golden Redhorse, and White Sucker are members of the sucker family (*Catostomidae*). The Northern Hog Sucker is generally associated with riffle habitat while the redhorse species prefer deeper pools and glides. The White Sucker is more prevalent in the upper Monocacy and the tributaries, but is found throughout the watershed.

The headwaters of several Monocacy tribuataries in the western watershed support populations of native Brook Trout (*Salvelinus fontinalis*) and naturalized populations of exotic Brown Trout (*Salmo trutta*). Brook Trout can be found in the Owens Creek, Hunting Creek, Fishing Creek, and Tuscarora watersheds and a single stream in the eastern watershed, Bear Branch. Brown Trout are found in the western watersheds of Owens Creek, Hunting Creek, and Ballenger Creek, though loss of habitat and an increase in impervious surfaces due to urban development has largely extirpated Brown Trout from the Ballenger Creek watershed. Trout species are also believed to have been extirpated from Glade Run and Furnace Branch in the eastern watershed. Natural and stocked trout resources in the Monocacy watershed provide recreationally and economically important sport fisheries.

Smallmouth Bass

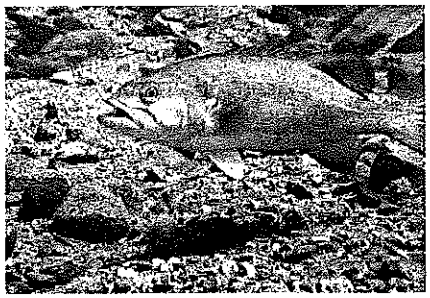
Smallmouth Bass (*Micropterus dolomieu*) and channel catfish (*Ictalurus punctatus*) are the most abundant and sought after sport fish in the Monocacy River. Prized for their tenacious fight and willingness to take lures, Smallmouth Bass generate economically important recreational fisheries. Smallmouth Bass are so well suited to the Potomac and Monocacy watersheds, many are surprised to learn that Smallmouth are not native to these waters. Albert M. Powell, a pioneer in the early Game and Inland Fish Commission, reported in his "Historical Information of Maryland's Commission of Fisheries with notes on Game" that Smallmouth were first introduced

Intersex

Intersex is a condition in which an organism displays both male and female sexual characteristics. The Potomac watershed received national attention when researchers discovered intersex in the form of testicular oocytes (immature eggs) in male Smallmouth Bass. A joint investigation by the US Fish and Wildlife Service, the US Geological Service, and the Maryland Department of Natural Resources found a high prevalence of intersex (82 – 100%) in Monocacy River Smallmouth Bass (Iwanowicz, et al., 2009). Further, the sources of the endocrine-disrupting chemicals associated with intersex conditions appear to be effluent from wastewater-treatment plants as well as runoff from agricultural land, animal feeding operations, and urban/suburban land.

The most sensitive stage for induction of testicular oocytes in Smallmouth Bass may be during sexual differentiation or within the first 2 to 3 weeks after hatching. In the Monocacy River, this period is generally during May and June. Spawning male Smallmouth Bass create circular nests in protected areas. Fertilized eggs within the nests can be exposed to contaminants associated with bottom sediments. Exposure at these early life stages can lead to a greater sensitivity to estrogenic exposure later in life. Atrazine is a widely used agricultural herbicide applied to emerging corn crops during the sensitive early life stages of Smallmouth Bass. A significant positive relationship between intersex in Smallmouth Bass and atrazine in the water column above bass nests has been documented. Moreover, a significant positive relation between intersex in Smallmouth Bass and total hormone/sterol in bed sediment at the nests has been observed (Kolpin, et al. 2013).

Additionally, exposure to estrogen reduces production of immune-related proteins in fish, suggesting that certain compounds, known as endocrine disruptors, may make fish more susceptible to disease (Iwanowicz and Ottinger, 2009). A recent study demonstrated that largemouth bass injected with estrogen produced lowered levels of hepcidin, an important iron-regulating hormone found in mammals, fish, and amphibians. The research suggests that estrogen-mimicking compounds may make fish more susceptible to disease by blocking production of hepcidin and other



immune-related proteins that help protect fish against disease-causing bacteria (Robertson, et al. 2009).

Skin lesions and spring mortality events of Smallmouth Bass, sunfish, and sucker species were first noted in the South Branch of the Potomac River in 2002. Since then, disease and mortality have also been observed in the Shenandoah and Monocacy Rivers. Despite much research, no single pathogen, parasite, or chemical cause for the lesions and mortality has been identified. The findings suggest that sensitive species may be stressed by multiple factors and constantly close to the threshold between a healthy and unhealthy condition. Fish health is often used as an indicator of aquatic ecosystem health, and these findings raise concerns about environmental degradation within the Potomac River drainage (Blazer, et al. 2010), including the Monocacy River.

into the Potomac watershed in 1854 when a small lot of bass from the Ohio River near Wheeling, WV were transported in the tender of Baltimore and Ohio Railroad locomotive and released into the Chesapeake and Ohio Canal at Cumberland. By 1865 it was reported that more than 200 miles of the Potomac River and its tributaries had been populated with Smallmouth Bass from the original introduction. The first documented stocking of Smallmouth Bass in the Monocacy occurred in 1862. Additional introductions took place through the mid-1900s, but were not well documented. However, with consistent natural reproduction and an abundant population, stocking was no longer necessary and was eventually discontinued. The Monocacy River has long been regarded as an excellent fishery for bass and catfish.

Environmental Concerns

A number of environmental stressors face the fish and other aquatic life in the Monocacy River.

Primary stressors include sedimentation, excessive nutrients, and chemicals of emerging concern known as endocrine disruptors. Land use in the Monocacy watershed is approximately 64 percent agricultural, seven percent urban, and 26 percent forested. Stormwater runoff over unforested land carries sediment and associated nitrogen, phosphorus and contaminants into the river. Sediment smothers gravel and cobble substrate reducing habitat quality for both fish and the invertebrates they feed on. High nutrient levels foster algal growth and increase habitat for snails, an intermediate host for many common fish parasites.

Chemicals in many detergents, pesticides, plastics, pharmaceuticals, and agricultural veterinary products are flushed into the Monocacy River by stormwater runoff. Once in the aquatic environment, this complex mixture of compounds can mimic hormones and elicit unnatural responses within the endocrine system of fish and other organisms. A high prevalence of skin lesions and spring mortality of mature Smallmouth Bass in the Potomac and James River watersheds indicates that they may be a sensitive indicator of environmental health in the Chesapeake Bay watershed (Blazer, et al. 2010).

Current Status and Monitoring of the Smallmouth Bass Fishery

The Department of Natural Resources, Freshwater Fisheries Program monitors the Monocacy River Smallmouth Bass by surveys of both the young and adult segments of the population. Populations in river environments are dynamic in nature and shaped by highly variable reproductive success and mortality. Annual haul seine surveys conducted during July have been used to measure the relative abundance of young Smallmouth Bass in the Monocacy since 1997. Relative yearclass strength is estimated by the average number of young bass captured per seine haul. High water levels and turbidity during the months of May and June are the primary factors that reduce spawning success and fry survival of Smallmouth Bass. No significant trends in yearclass strength were identified between 1997 and 2013; Smallmouth Bass reproduction has been sufficient to maintain an attractive recreational fishery (MD DNR, 2013).

The adult segment of the Smallmouth Bass population is monitored by conducting electrofishing surveys at least once every three years using boat or barge-mounted equipment. A substantial fish kill occurred in the upper Monocacy River during May, 2009 following a high water event: The kill primarily affected adult Smallmouth Bass and sucker species. To date, no single, specific biological or chemical "cause" for the mortality has been identified, despite much research by state, federal, and other investigators. Population estimates determined during the fall of 2008 and 2009 using barge-mounted electrofishing equipment documented declines in adult Smallmouth Bass biomass and density near 60 percent (Maryland DNR, 2011). By 2013, surveys suggested that the Monocacy River Smallmouth Bass population had recovered from the 2009 fish kill. Further, the 2013 survey documented biomass and density values for legal length bass that were higher than pre-fish kill values recorded in 2008 (Maryland DNR, 2013). Smallmouth Bass biomass estimates from the Monocacy River compare favorably with other mid-Atlantic rivers.

Electro-fishing

Amphibians and Reptiles

The riparian environment and its associated flood plain and wetlands provide a vital, moist habitat for amphibians. Amphibian species diversity and composition may be affected by flood conditions. High water can disperse species to different regions, and during low-flow conditions, amphibians are often restricted to one area. (14)

Many different species of reptiles live in the Monocacy River Valley. Snakes and lizards may be found in stream valley bottoms as well as upland areas. Turtle habitats include streams, wetlands, forests, and other moist areas. (See Appendix,

Amphibians and Reptiles.)

Waterfowl and Other Birds

Avian species found in the region include waterfowl, birds of prey, gamebirds, and songbirds. Waterfowl habitat includes vegetated areas along streams. One of the greatest concentrations of waterfowl may be observed from Michael's Mill Dam through the Monocacy Natural Resources Management Area to the river's confluence with the Potomac. This region also has numerous pockets of wetlands and channels which provide an expanded habitat favorable for waterfowl (14).

Mallards, Blue and Green Wing Teal, Mergansers, Black Duck, and Pintail are bottomland ducks that have been sighted in the watershed. Mallards and Wood Ducks breed locally. More transient ducks include the American Widgeon, Ring Neck Duck, and Ruddy Duck. Canada Geese are occasional year-round residents.

A graceful wading bird that inhabits the lower Monocacy is the Great Blue Heron. Its smaller cousin, the Green Heron, may also be observed wading in shallow areas. The Solitary Sandpiper and Spotted Sandpiper are temporary visitors.

Fish, amphibians, reptiles, and small mammals within the River provide a varied food source for predatory birds. Permanent predatory birds include the Red Shouldered, Redtailed, Sharp Shinned, and Cooper's hawks, and the Osprey. The Broad Wing Hawk is also present along the River. The Kestrel, a member of the Falcon family, is common, as well as Bald Eagles. Owls such as the Screech, Barred, and Great Horned are seen in the watershed. Quail, pheasant, and wild turkey are also present in the watershed.

Recommendations

5-1) Frederick and Carroll Counties, the City of Frederick, and the Town of Walkersville should consider identifying the Monocacy River as a "High Conservation Value" area and actively support the environmental enhancement of the River by employing a wide range of economic incentives, financial aid, and technical assistance for landowners to protect, maintain, and restore the habitat and water quality functions of the forestlands and wetlands along the Monocacy River

5-2) The River Board encourages Frederick County landowners along the Monocacy River to participate in Frederick County's voluntary "Creek ReLeaf" reforestation program, which pays landowners to plant trees along watersways for habitat improvement and water quality protection

5-3) Consider establishing the Monocacy River area as a priority area in Frederick County, Carroll County, and the City of Frederick, for Forest Resource Ordinance (FRO) easements. The Town of Walkersville Comprehensive Plan states that required FRO plantings will be directed to the Monocacy River, Glade Creek, and Israel Creek stream valleys

5-4) Implement action item NR-A-05 from the Frederick County Comprehensive Plan which states, "Target areas along the Monocacy River as FRO priority areas (forest plantings and banking) in addition to streams in the agricultural zoning district"

5-5) Establish a mainstem Monocacy reforestation program by utilizing Frederick County's Fee-in-Lieu FRO funds to purchase easements (existing forest or new tree plantings) within the River's floodplain

5-6) The City of Frederick should undertake an analysis of the River's riparian forest buffer on the Clustered Spires Golf Course with active management of the tree canopy and understory vegetation to enhance the ecology and morphology of the River's floodplain forest. As the Clustered Spires Golf Course is located within the

River's floodplain, the City should critically examine the use of conventional fertilizers and pesticides and less toxic alternatives to lessen chemical inputs into the River

5-7) *Frederick County and Frederick City should lead by example and employ Monocacy Scenic River Best Management Practices (MSR-BMP) to reforest, where feasible opportunities exist, their public land holdings along the Scenic Monocacy River*

5-8) *The River Board should request the Maryland Department of Natural Resources to evaluate the Monocacy River area in its future update of the State Forest Legacy Assessment of Need, and Strategic Forestland Assessment for possible inclusion of the River area in a revised Maryland Forest Legacy Area*

5-9) *Both Counties should continue to provide support and assistance to the efforts of the Maryland Department of Natural Resources' Forest Service in control of forest disease/pests, i.e., Gypsy Moth, Emerald Ash Borer, Hemlock Woolly Adelgid, etc.*

5-10) *Both Counties should continue to provide support and assistance to the efforts of the Maryland Department of Natural Resources' Freshwater Fisheries Program in their study and analysis of the Monocacy River's fish species, as well as stocking for the recreationally and economically important sport fisheries in the Watershed*

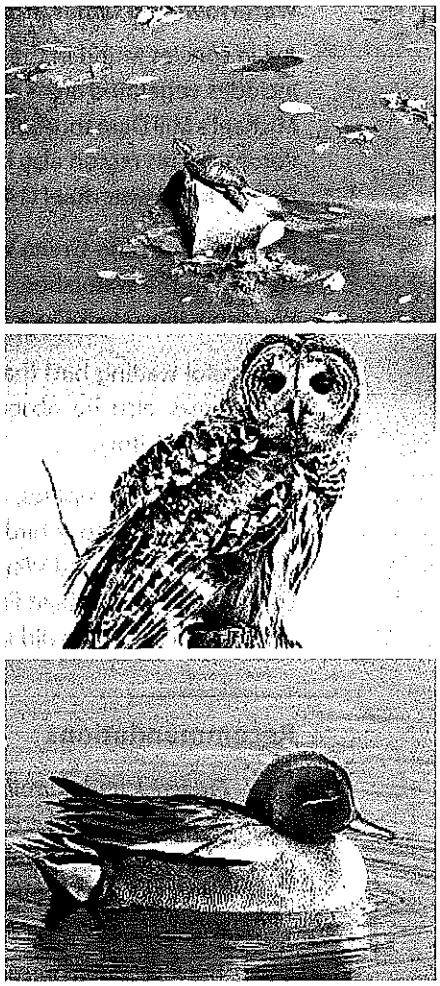
5-11) *The Counties, the City of Frederick, the Town of Walkersville, and the River Board should support the efforts of environmental organizations, civic groups, and other non-governmental orgainzations (NGOs) in tree planting projects, wetland enhancements, or environmental education/outreach initiatives*

5-12) *The River Board encourages Carroll and Frederick Counties to incorporate climate change related impacts and risks (to public safety, health, and welfare, and infrastructure, natural resources, structures, etc.) related to Monocacy River flooding in their respective Hazard Mitigation Plans*

5-13) *The River Board encourages both Counties to incorporate the following elements in their respective Hazard Mitigation Plans, in case of a spill of hazardous toxic materials into the Monocacy River:*

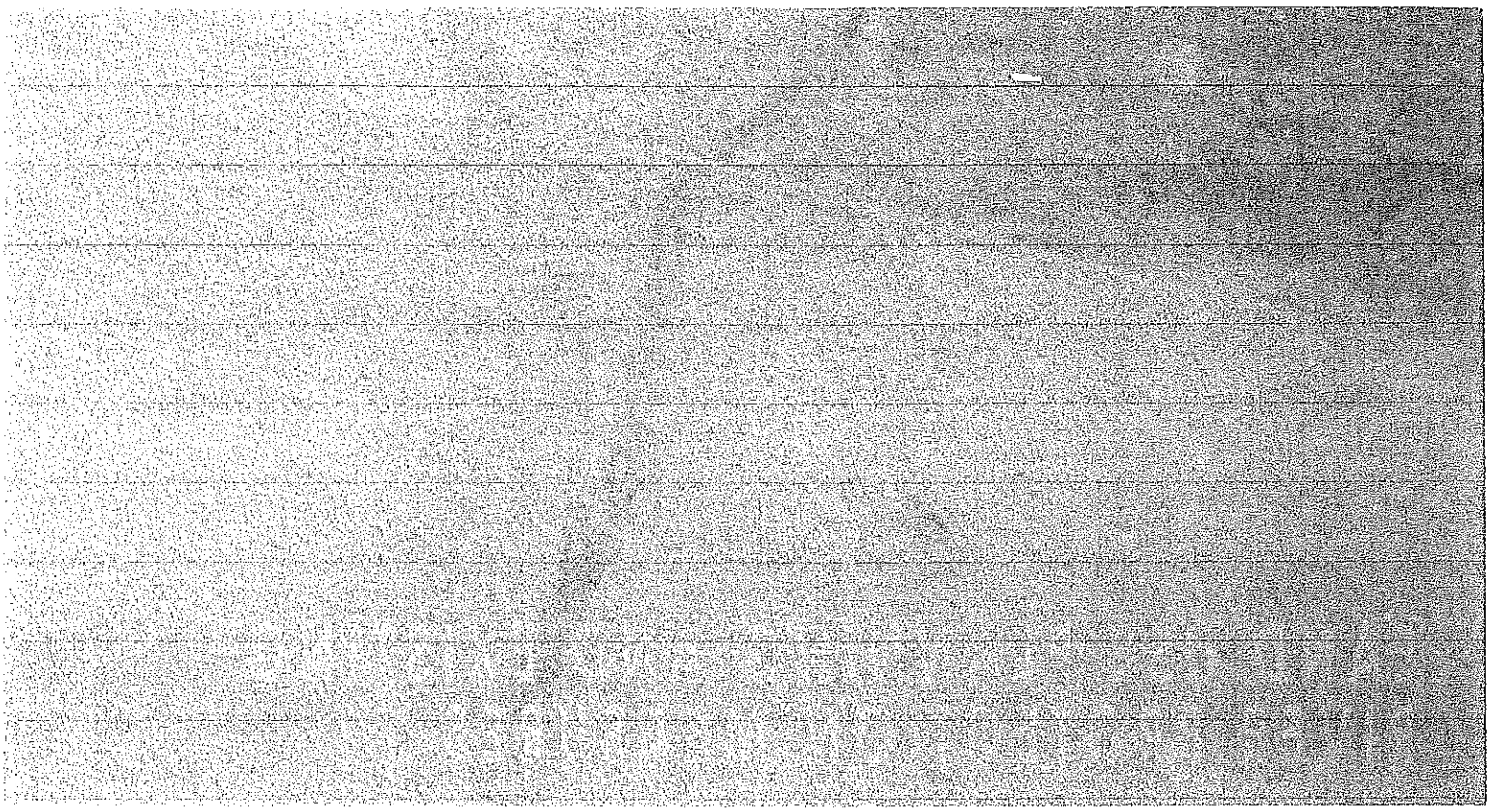
- *Identification of hazardous chemical sites (storage,usage, etc)*
- *Spill event detection, including responsible party identification*
- *Monitoring of contaminant properties, including health effects*
- *Emergency response/clean-up operations*
- *Follow-up tracking, including regulatory response*

5-14) *Encourage the Frederick and Carroll County Forestry Boards to expand their responsibilities (and offer additional county resources if needed) to include the review and field check of permit applications for timber harvesting along the Monocacy River area to ensure that sound forestry management practices and water quality protections are being employed (Frederick County currently requires forestry board involvement in timber harvesting only for properties zoned resource conservation)*



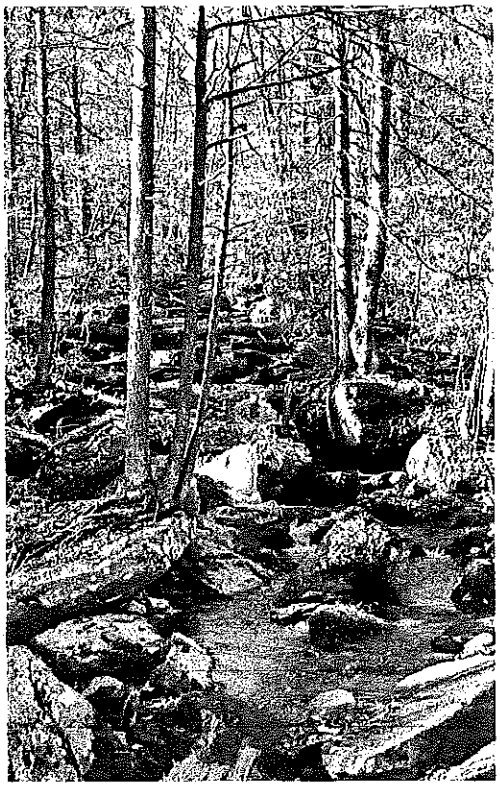
5-15) The River Board should engage with the Maryland Wood Duck Initiative to implement a project to install nesting boxes along the River for waterfowl (e.g. Wood Ducks) and other birds, with possible assistance from the Parks Departments of Frederick County and the City of Frederick

5-16) Both counties are encouraged to reach out to landowners about voluntary programs and other financial assistance ato meet the goals of sustainable land use, best management practices, and activities that protect the River and the Monocacy River Watershed.



[illegible] not at her banks,
[illegible] who have loved her.

Buffalo Joe



Little Marsh Creek,
a Monocacy River tributary in Adams County, Pennsylvania

AND EXISTING EASURES

MD 80, Fingerboard Road

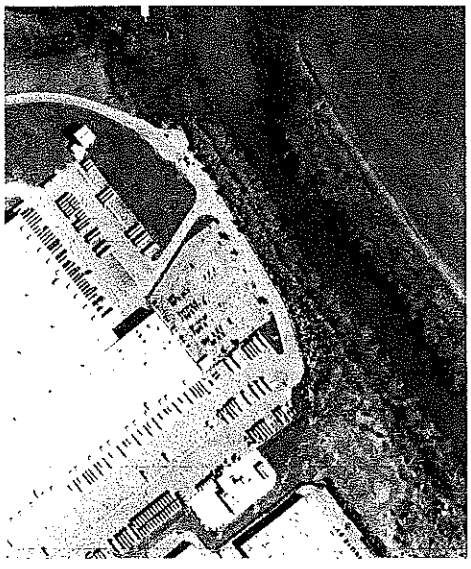
Introduction

The future of the Monocacy River and its tributaries will be determined by proper land use planning and water resources management. Frederick and Carroll Counties have comprehensive plans, Total Maximum Daily Load (TMDL) restoration plans, stormwater plans, and land preservation plans to address community growth, economic development, and environmental protection. The Comprehensive Plans for Frederick County, the Town of Walkersville, and the City of Frederick, and Carroll County's Master Plan are planning tools that provide direction for accommodating desirable development, and employment opportunities while maintaining the quality of life and natural habitats. The plans address many concerns, including transportation, schools, parks and open space, different types of development and agriculture. An understanding of existing local land use and water resources management plans and related state and federal programs is an important component of the Monocacy River Management Plan.

The existence of significant natural resources---like an officially designated scenic river---should be a primary factor in how decision makers determine the location, extent, and type of land use, future growth and development in a community. The City of Frederick, Frederick County, Carroll County, and the town of Walkersville each have different visions, adopted plans, policy guidance, and land management to address the Scenic Monocacy River.

Historically, towns and communities were located along the River out of necessity for transportation and early industrial opportunities. While smart growth principles efficiently focus our human settlement into existing established communities and wisely-located growth areas, sustainable development along the River should seek to impose limited or no ecological degradation or limited or no environmental externalities.

The alteration, conversion, and development of land in close proximity to the River conveys permanence to the lost opportunity for establishing a healthy, vibrant, scenic, and resilient natural environment along the Monocacy River



Monocacy River

The costs and impacts of permanent conversion and encroachment of the River's natural riparian landscape are imposed on and borne by society as a whole. For example, replacing forests or natural fields next to the River with structures and impervious surfaces prevents infiltration of groundwater, exacerbates stormwater runoff, increases flooding risks, eliminates wildlife habitat, increases nutrient and sediment loads, and lessens the River's scenic qualities. River encroachments degrade the overall River resource and ecology.

As discussed throughout this Plan, enhancement of the River has multiple social, economic, and environmental benefits. From maximizing ecosystem services (water quality and flood protection, nutrient uptake, and habitat provision) to a display of community stewardship and pride, or natural 'asset' management, with its accompanying economic return, the Monocacy River has stature and standing and deserves a prominent place in the social and political domain. The River should not be viewed as a secondary afterthought in land use planning or a hindrance in land use. Collective action is needed to ensure a resilient and sustainable Monocacy River directly through policy and regulation that incentivizes landowners, farmers, and developers to maintain a healthy, productive, and functioning River system.

History of State Land Use Planning

Maryland has a very long history of state level planning dating back to the 1920's with the establishment of a State Planning Commission and the adoption of Article 66B, which provided local governments that implement planning and zoning with guiding legislation. Since the 1990's the State has taken a proactive role in implementing smart growth principles on a statewide level and mandating the inclusion of new comprehensive plan elements. Some notable State legislation addressing land use is summarized below:

Planning Act of 1992

The Economic Growth, Resource Protection, and Planning Act, amended Article 66B of the Annotated Code of Maryland (now referenced as the Land Use Article of the Annotated Code of Maryland), which centered on concentrating development in suitable areas, protecting sensitive natural resources, and establishing funding mechanisms to achieve the following Planning visions:

- Development is concentrated in suitable areas.
- Sensitive areas are protected.
- In rural areas, growth is directed to existing population centers and resource areas are protected.
- Stewardship of the Chesapeake Bay and the land is a universal ethic.
- Conservation of resources, including a reduction in resource consumption,

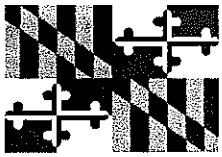
is practiced.

- To assure the achievement of items (1) through (5) of this section, economic growth is encouraged and regulatory mechanisms are streamlined.
- Adequate public facilities and infrastructure under the control of the county or municipal corporation are available or planned in areas where growth is to occur.
- Funding mechanisms are addressed to achieve these Visions.

The 1992 Planning Act also required local governments to review and, if necessary, update their Comprehensive Land Use Plans on a six-year cycle, and to incorporate and implement the Planning Visions through the Comprehensive Plan.

1997 Priority Funding Areas Act

The 1997 Priority Funding Areas Act directs State funding for growth-related infrastructure to Priority Funding Areas (PFAs), providing a geographic focus for State investments in growth. PFAs are existing communities and places where local governments want State funding for future growth. Growth-related projects include most State programs that encourage growth and development, such as highways, water and sewer system construction, economic development assistance, and State leases or construction of new office facilities. The 1997 PFA Act also established the Rural Legacy Program that provides funding to identify and protect the State's most valuable farmland and natural resource areas.



2006 Land Use Planning Initiatives

The 2006 Maryland Legislative session produced several planning related requirements that modify the way Maryland's counties and municipalities exercise planning and zoning authority. The specific legislation was House Bill 1141 and House Bill 2, described below:

- Water Resources Element (WRE)—addresses the relationship between water and wastewater capacities with planned growth. The three components of the WRE include drinking water supply; wastewater treatment and disposal; and nonpoint source pollution and stormwater management
- Municipal Growth Element—requires municipalities to identify areas for future growth consistent with a long-range vision, coordination with County governments and recommends the use of joint planning agreements between the municipality and the county
- Priority Preservation Element—for counties with certified agricultural land preservation programs, it requires 'priority areas' to be identified, prioritized, and targeted for preservation

Smart Growth and Sustainable Growth Act of 2009

These amendments to the Land Use Article were geared towards protecting Maryland's environment and natural resources and to promote sustainable growth in Maryland. In addition, the new Planning Visions law modernizes the State's eight existing planning visions with 12 new visions that reflect more accurately Maryland's ongoing aspiration to implement sound growth and development policy.

QUALITY OF LIFE AND SUSTAINABILITY: a high quality of life is achieved through universal stewardship of the land, water, and air resulting in sustainable communities and protection of the environment;

PUBLIC PARTICIPATION: citizens are active partners in the planning and implementation of community initiatives and are sensitive to their responsibilities in achieving community goals;

GROWTH AREAS: growth is concentrated in existing population and business centers, growth areas adjacent to these centers, or strategically selected new centers;

COMMUNITY DESIGN: compact, mixed-use, walkable design consistent with existing community character and located near available or planned transit options is encouraged to ensure efficient use of land and transportation resources and preservation and enhancement of natural systems, open spaces, recreational areas, and historical, cultural, and archeological resources;

INFRASTRUCTURE: growth areas have the water resources and infrastructure to accommodate population and business expansion in an orderly, efficient, and environmentally sustainable manner;

TRANSPORTATION: a well-maintained, multimodal transportation system facilitates the safe, convenient, affordable, and efficient movement of people, goods, and services within and between population and business centers;

HOUSING: a range of housing densities, types, and sizes provides residential options for citizens of all ages and incomes;

ECONOMIC DEVELOPMENT: economic development and natural resource-based businesses that promote employment opportunities for all income levels within the capacity of the State's natural resources, public services, and public facilities are encouraged;

ENVIRONMENTAL PROTECTION: land and water resources, including the Chesapeake and coastal bays, are carefully managed to restore and maintain healthy air and water, natural systems, and living resources;

RESOURCE CONSERVATION: waterways, forests, agricultural areas, open space, natural systems, and scenic areas are conserved;

STEWARDSHIP: government, business entities, and residents are responsible for the creation of sustainable communities by collaborating to balance efficient growth with resource protection;

IMPLEMENTATION: strategies, policies, programs, and funding for growth and development, resource conservation, infrastructure, and transportation are integrated across the local, regional, state, and interstate levels to achieve these Visions.

2012 Sustainable Growth and Agricultural Preservation Act

Commonly known as the 'Septic Bill,' this law addresses rural land development that utilizes on-site sewage disposal systems—septic systems, and requires the identification of "Tiers" that describe the locations where the use of septic systems for residential subdivision is more tightly managed.

Comprehensive Plans for the River

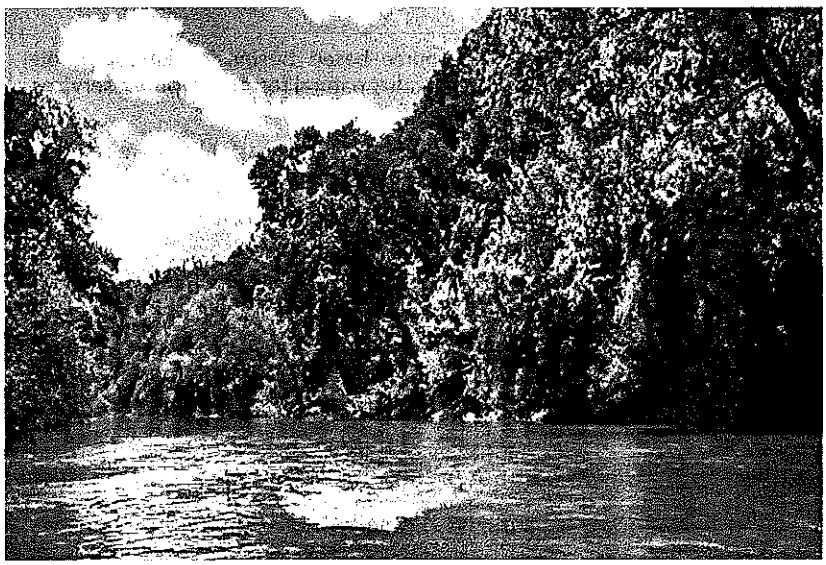
Frederick County

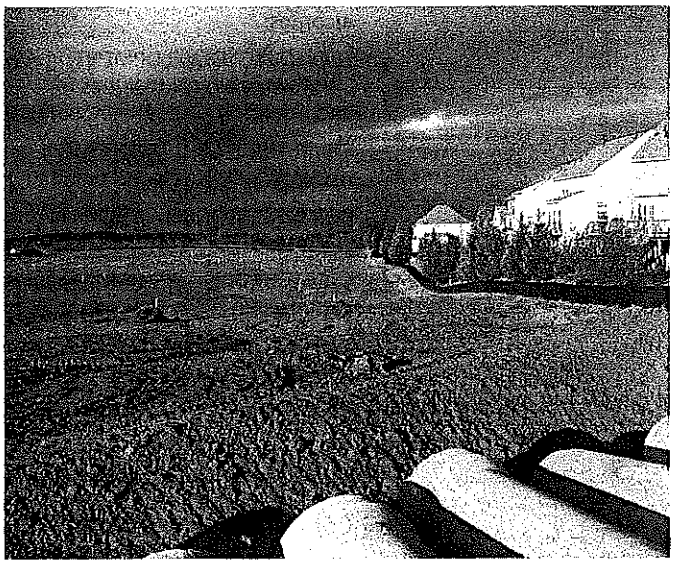
Frederick County's Comprehensive Plan, Many Places, One Community, was adopted in 2010, with revisions made in 2012. The Comprehensive Plan, as required by State law, is a grand, comprehensive vision of the future of the County and is designed to guide all decisions regarding land use and development. The Plan recognizes the uniqueness of the County, its assets and history that make Frederick County what is today.

The Monocacy River flows for most of its 58 miles through Frederick County, meandering through fertile agricultural land, rich floodplain forests, unique topography and geology, past parkland (e.g., Monocacy Battlefield, Pinecliff Park), historic villages (Bridgeport, Ceresville, Buckeystown, Greenfield), and under 25 bridges. The River is a defining landscape element that knits the fabric of both Frederick County's and Carroll County's histories and communities. Approximately 75 percent of the County's land area is located within the Monocacy River Watershed. Over the years, population growth and land development has moved outward from Frederick City into the County

and crossed and engulfed the Monocacy River.

The County's Natural Resource land use designation is described in the 2010 Comprehensive Plan and is used "to identify significant natural resource features to provide guidance for the application of the Resource Conservation Zoning District and other resource protection strategies." The primary features designated Natural Resource, according to the Comprehensive Plan, include mountain areas and the extent of contiguous forest, major streams defined by the County's 20 subwatersheds, and the State's Green Infrastructure features. The Natural Resource land use designation is applied to the entirety of the FEMA 100-year floodplain along the Monocacy River and much, but not all, of the forestlands directly adjacent to the River and its floodplain in Frederick County.





The County's Comprehensive Plan also states, "Natural Resource areas would also support the delineation of natural boundaries for Community Growth Areas." Frederick County's Community Growth Areas include the Monocacy River's floodplain and steep, forested slopes directly adjacent to the River. The River Board questions the delineation of the Community Growth Area as an inclusive boundary, one that incorporates Natural Resource-designated sensitive River resources within areas indicated for growth and development. A Monocacy River-affirming policy is the exclusion of River resources from the County's Community Growth Areas.

The Resource Conservation (RC) zoning district in Frederick County generally matches the areas where the Natural Resource land use plan designation is applied. The RC zoning district is defined in the County Zoning Ordinance as follows: "The purpose of the Resource Conservation Zoning District is to allow low intensity uses and activities which are compatible with the goals of resource conservation to be located within mountain and rural wooded areas. Areas within this district include mountain areas, rural woodlands, and cultural, scenic, and recreation resource areas. Environmentally sensitive areas within the resource conservation zone, including FEMA floodplain, steep slopes, wetlands and the habitats of threatened and endangered species, will be protected from development" (§ 1-19-5.210, Frederick County Code). The RC zoning district permits subdivision of land and requires a 10 acre minimum lot size. Lots to be used for building must contain an area outside of the floodplain sufficient for placement of structures, septic systems, and wells (§ 1-16-

200, Frederick County Code).

The RC zoning district also prohibits buildings and structures on slopes greater than 25% and forest clearing is limited to an area of 40,000 square feet for each home site. Commercial logging is permitted in the RC zone subject to review and approval by the Frederick County Forestry Board. No new public streets are permitted within the RC zone.

Carroll County

Adopted in February 2015, the 2014 Carroll County Master Plan is the second revision to the original 1964 plan. The quality of life afforded to County residents has and continues to entice new residents to the County today as evidenced by safe neighborhoods, good schools, relatively uncongested roads, and attractive, less expensive housing and cost-of-living compared to surrounding jurisdictions.

Carroll County is bordered to the north by Pennsylvania, to the west by Frederick County, to the south by Howard County and the east by Baltimore County, Maryland. It encompasses approximately 456 square miles. Carroll County has a population of 172,098 people and 62,193 households as of November 2015. (http://ccgovernment.carr.org/ccg/compplanning/Demographics/HouseholdByElectionDistrict.pdf)

Carroll County's Future Vision

Carroll County is a great place to live, work, and play. The County conserves and promotes its unique rural agricultural heritage, protects its environmental resources, and promotes a balanced approach to new development and economic opportunities consistent with the fabric of its communities. Carroll County values, and citizens' unalienable rights of life, liberty, and property, are respected, protected, and sustained.

The 2014 Master Plan outlines 15 goals to promote the public health, safety, and welfare. The vision of the Master Plan is achieved through these goals. Of the 15 goals, nine relate to the County's commitment to conservation and coordination of these efforts. These goals are as follows:

Goal 1
Promote communication and coordination between and among the County, the municipalities, and state and regional jurisdictions on projects and issues of mutual concern. Encourage the involvement of the community in developing, amending, and implementing the Master Plan.

Goal 2
Ensure respect for unalienable individual rights; encourage community involvement in planning in an open two-way communication process; encourage the involvement of the community in planning and implementing the Master Plan; provide participants with a balanced perspective on planning goals while promoting the need to respect private property rights; and accurately advise participants of the tradeoffs between various forms of development based on real-world effects.

Goal 3
Protect and enhance the water quality of Carroll County's rivers, streams, reservoirs, and aquifers; comply with applicable state and federal requirements related to water quality and quantity; and maintain and protect adequate water supplies to serve current and planned development.

Goal 7
Preserve at least 100,000 acres of agricultural land to support the production of agricultural products and promotion of related agribusiness.

Goal 8
Preserve 80 percent of undeveloped land in the Priority Preservation Area, as adopted by the Board of County Commissioners.

Goal 9
Provide an affordable, coordinated and comprehensive system of public and private parks, recreational

facilities and programs, and open space that will enhance our communities.

Goal 10
Preserve the county's historic, cultural, scenic, and architectural heritage.

Goal 11
Protect, maintain, and restore, where feasible, the environmental resources and natural ecosystems in the County by promoting land use practices that are in balance with, and minimize the effects on the natural environment, subject to appropriate cost/benefit analysis.

Goal 14
Facilitate a development pattern that remains consistent with the fabric of our communities, is in harmony with the surrounding built and natural environments, encourages community interaction and, in rural areas, preserves the County's rural character.

Goal 15
Pursue policies that facilitate development in appropriate areas, including the Designated Growth Areas (DGAs), thereby protecting and conserving agricultural and environmental resources, preserving open space, and providing public facilities and services efficiently and cost-effectively.

Development in Carroll County has been guided by a master plan since 1964. The basic premise of the plan has been to direct development into and around the County's nine DGAs while retaining the rural character and agricultural use of the surrounding land. Implementation of that premise was strengthened in 1978 through the adoption in the subdivision regulations of a lower density lot yield calculation formula for properties in the Agricultural Zone.

The 2014 Carroll County Master Plan designates over 88 percent or approximately 203,000 acres, of the land to Agriculture and Resource Conservation uses. These designations will then equate to Agricultural and Resource Conservation Zoning districts with the implementation of the Plan. The majority of the Monocacy River Watershed in Carroll County is comprised of these lands.

Carroll County's Master Plan designation of resource conservation is applied to the majority of the land and resources adjacent to the Monocacy River and extends eastward to include the entirety of many large agricultural properties.

The agricultural land use designation is shown on the final 4.3 miles of the River in Carroll County (from approximately Sixes Bridge Road to Double Pipe Creek), which includes the same resources --- FEMA floodplain, forestlands, agricultural properties, etc---as the northern portion of the River that has a resource conservation land use designation.

The 2014 Carroll County Master Plan defines resource conservation areas as "land that is occupied by natural or environmental resources, including wooded areas and forests, wetlands, streams, ponds, steep slopes, floodplains, natural vegetation, fish and wildlife and their habitat. These are areas where, because of natural geographic features, it is considered feasible and desirable to conserve open spaces, water supply sources, woodland areas, wildlife, and other natural resources. This may include extensive steeply sloped areas, stream valleys, water supply sources, and adjacent wooded areas. Residential, commercial, and industrial development should be directed to areas with a land use classification for that purpose."

The agricultural land use designation is defined as "the use of land for growing of crops, dairying, pasturage, horticulture, floriculture, viticulture, or animal/poultry/honeybee husbandry."

The County's conservation zoning district permits subdivision of land with a three acre lot size for residential uses and a five acre lot size for all other permitted uses within the conservation zone (§1-158.071 Carroll County Code). The County is currently revising its conservation zoning regulations

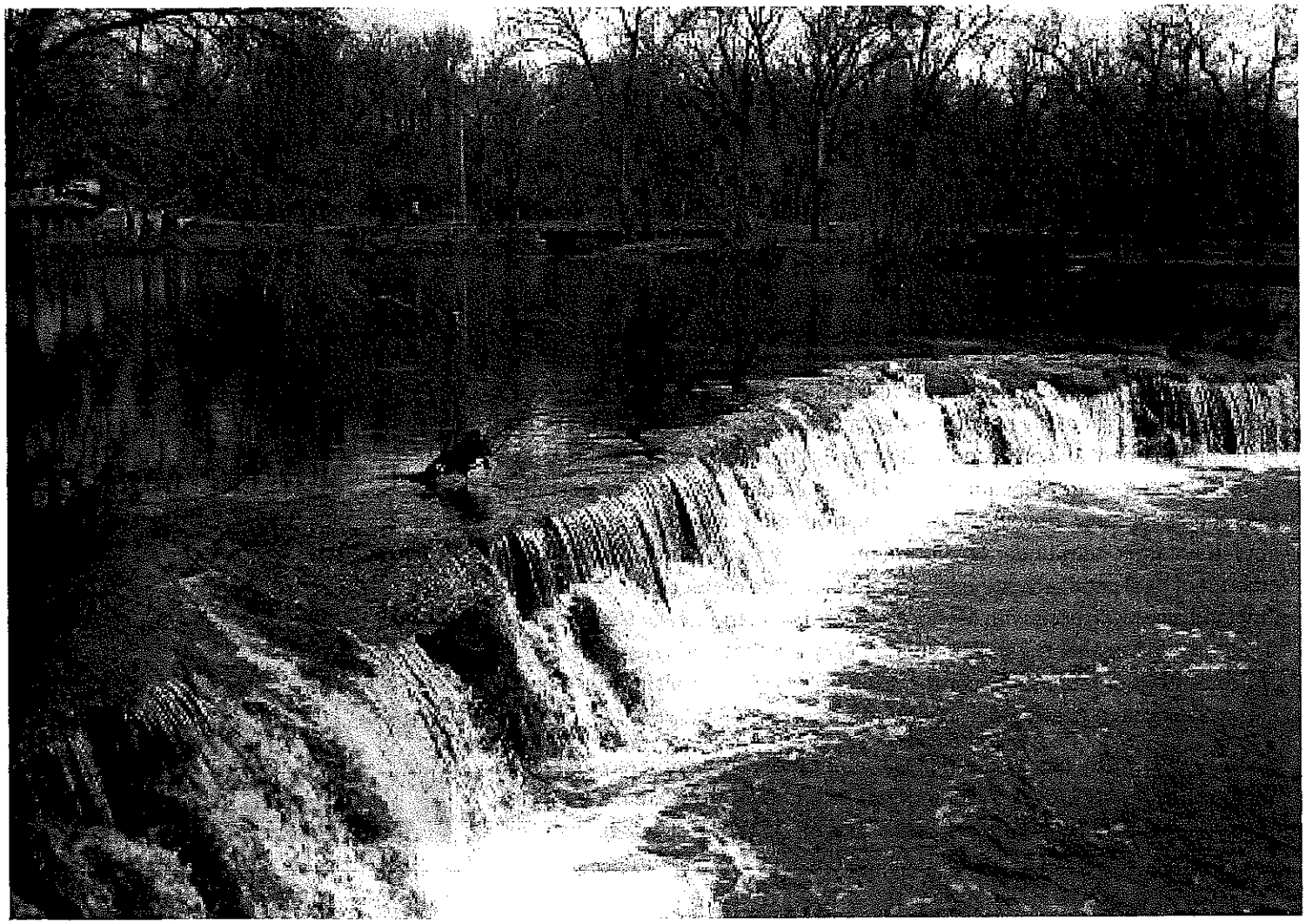
as well as undertaking a countywide comprehensive rezoning to implement the 2014 Master Plan.

The City of Frederick

Established in 1745, The City of Frederick is the County seat of Frederick and is the third largest municipality in Maryland. Its location in the geographic center of Frederick County, with the convergence of several major interstate highways, makes the City the economic, cultural, and population center of Frederick County. The Monocacy River winds through the City for approximately nine miles.

The City's population has nearly doubled in 25 years since the original Monocacy River Plan was published, increasing from 40,148 (1990 Census) to the City estimate of 70,400 persons in 2015. Municipal annexations, whereby a city or town enlarges its borders by adding land adjacent to its current borders, has been the primary driver of population growth in the City of Frederick. The City projects a 2030 population of 92,000.

The City of Frederick acknowledges that the Monocacy River is "one of the City's most important natural resources" as stated in their 2010 Comprehensive Plan. However, the list of the Sensitive Areas addressed in the City's 2010 Plan does not specifically include the Monocacy River (page 76, Chapter



Starner's Dam

4 , Municipal Growth Element). Detailed mention of the River is subsumed by the statement about the River's watershed, contained in the Municipal Growth Element of the 2010 Plan: "Given the Monocacy River watershed's importance to Frederick and the diversity of its sensitive areas, this habitat should continue to receive special consideration." The critical reader may ask to where "this habitat" is referring—the sensitive areas within the River or the sensitive areas in the River's watershed (the entire City is located within the River's watershed).

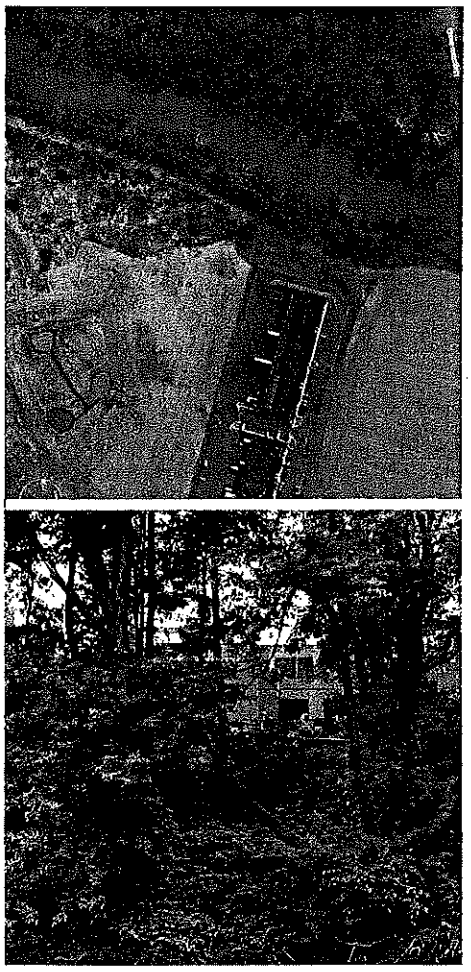
The City has secured land along the Monocacy River for trails, open space, public parkland, and forest protection as part of the land development process, but results are somewhat inconsistent and lack coherence, with widely varying widths of open space along the River. In some cases, land development has encroached within 20 feet of the Monocacy River, impacting the health, productivity, and resiliency of the River, the River's water quality, and wildlife habitat.

The City has laudable goals and policies relating to water quality, environmental protection, and parkland contained in their 2010 Plan, including the following notable adopted policies:

- Provide an adequate and safe drinking water supply to serve the existing and future residents of the City of Frederick
- Encourage protection and restoration of ecologically sensitive lands to protect water quality and to conserve and increase forest canopy
- Minimize the environmental impacts of development through Best Management Practices
- Continue to identify opportunities for additional parks and open space

There is no policy in the City's Comprehensive Plan that specifically addresses protection, enhancement or management of the Monocacy River, a State-designated Scenic River that flows for approximately nine miles through the City. However, two City policies regarding annexations and land development are clear and could easily be interpreted and implemented to better address River management and protection. Chapter 6 of the City's Comprehensive Plan states, "Development plans for annexed area should take into consideration the effects of new development on surrounding natural resources." An implementation item under Environmental Policy No. 5 states, "Increase the amount of dedicated recreation land located outside of floodplain areas." The City (and all jurisdictions with Monocacy River-front land within their borders) should recognize that the River's riparian environment and related resources are comprised of more than just the 100-year FEMA floodplain, which is the minimal default regulatory element.

Since 1990, the City has annexed into their borders approximately 700 acres along the Monocacy River, including two recent River-front areas: 110 acres along the River at Biggs Ford Road, and 52 acres on the west side of the River, south of I-70. While these 2 recent annexation areas remain undeveloped in



Land Development in close proximity to the Monocacy River

2015, the City, during its future development review and approval process, has an opportunity to actively engage and apply its land use policies to ensure a productive and healthy River ecology, protect sensitive River resources and enhance the scenic and recreational features of the River.

The Town of Walkersville

The Town of Walkersville (2010 population: 5,800) also borders the Monocacy River, with just 1.5 miles of River-front land within its current borders. The Town's 2011 Comprehensive Plan describes and depicts a future Town boundary--annexation limit-- that extends further westward and runs nearly 3.5 miles north along the Monocacy River to Devilbiss Bridge Road. The vast majority of the lands within the future annexation limit, now in the County, are enrolled in the County's Agricultural Preservation Program. The Town's Plan describes these preserved farms as its "Agricultural Buffer," which will act as a permanent development buffer between the City of Frederick and the Town.

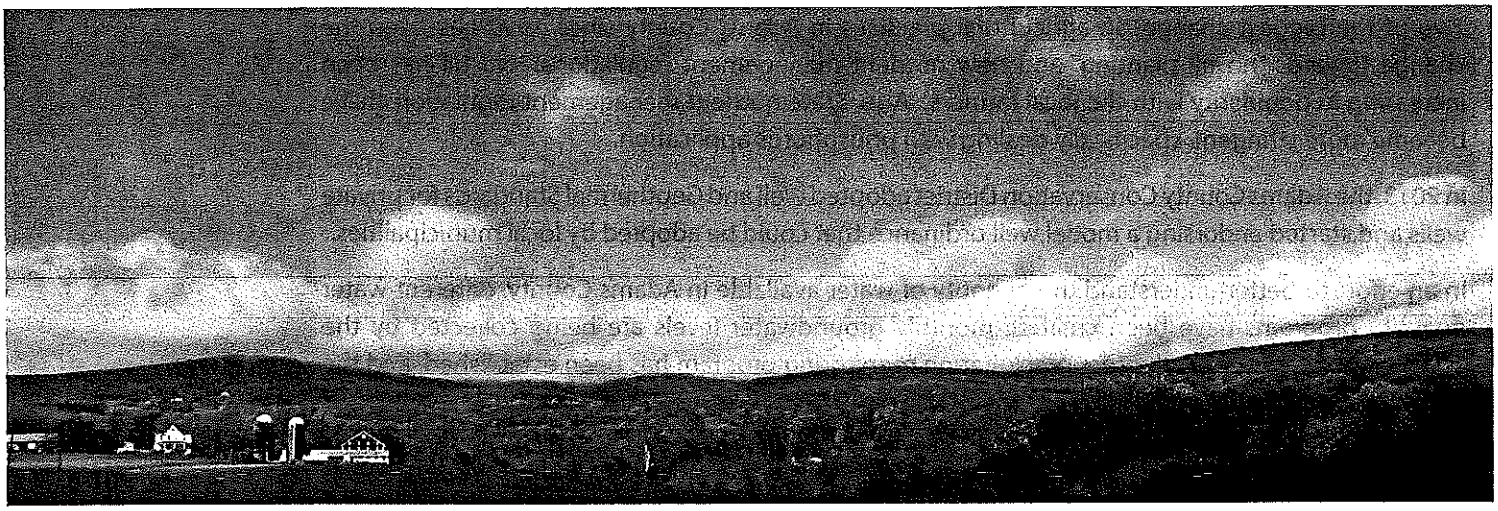
Another small area extending 0.80 miles along the River south of the existing Town boundary is also shown for future annexation, which would bring the total Monocacy River-front land within the Town of Walkersville (after annexation) to 5.9 miles, from Devilbiss Bridge Road south to MD 26, Liberty Road. This southern annexation area is part of the 290-acre "Monocacy River—Waterside" Ecological Significant Area (ESA).

The Town's Plan has very succinct descriptions of floodplains, aquatic and terrestrial resources, as well as 'conflicting activities.' The Natural Features chapter, page 38, states:

"The areas along rivers and streams require careful management, not only to protect property from damaging floods, but also to avoid overburdening or losing these resource areas. Potentially conflicting activities, such as agriculture, recreation, manufacturing and wastewater treatment often depend on nearby water sources. Streams and rivers, along with their associated floodplain and woodland areas, are also environmental resources, serving as wildlife habitats and corridors for wildlife movement."

The Town's Plan also identifies the Monocacy River as a priority area for forest plantings as part of the Forest Conservation Act (administered by Frederick County).

Photo by Kai Hagen



Adams County, Pennsylvania

Land Use and Water Resources

Adams County is located in south-central Pennsylvania (PA) along the Maryland border, surrounded by Cumberland, Franklin and York Counties in PA, and Carroll and Frederick Counties in Maryland.

The county covers a total of 526 square miles which is divided between two major watersheds. The southwestern half drains into the Potomac River by the Monocacy tributaries. Approximately 44 percent of the county falls within the Monocacy Scenic River Watershed area; the Rock and Marsh Creek Watersheds cover about 143 square miles, or about 27 percent of the county. The Monocacy's headwaters begin in Adams County, Pennsylvania. Land use and water resource management in this part of the upper watershed does effect the River's water quality and quantity.

Adams County Population

Year	Population
1990	78,274
2000	91,292
2010	101,407
2030 (projected)	128,893

Adequate water supply, water quality, and the protection of water resources have been ongoing concerns in Adams County for many years. Since counties are only advisory due to the governmental structure in PA, the State and local municipalities are charged with enacting and enforcing regulations on water supply, water quality or protection of water resources.

Surveys by the Pennsylvania Department of Environmental Protection have been completed to see if the streams were attaining the water quality standards based on the designated or existing use(s) of each stream. Some sections of the streams have been found not to meet their designated use (also known as "impaired"). Little Marsh Creek, Marsh Creek, Mummasburg Run, Plum Run, Rock Creek, Stevens Run, White Run, and Willowby Run all have sections that are considered impaired. The sources for impairment are listed as Agriculture, Industrial Point Sources, Small Residential Runoff, Urban Runoff/ Storm Sewers. The causes of the impairments are from excess nutrients, siltation, and unknown toxicity. The streams are resurveyed when necessary.

In 2012, Toms Creek and Middle Creek were surveyed for the abundance of Fecal Coliform Bacteria. Elevated levels of bacteria were present throughout most of the two watersheds as they passed through residential and agricultural areas. However, the sources of the bacteria have not been identified.

Two of the biggest changes in agricultural practices in Adams County since 1990 has been the change towards "no till planting" and new nutrient management regulations. No till has been increasing in popularity with the local farmers. Also, State nutrient management regulations have become more stringent, specifically dealing with phosphorus application.

In 2013, the Adams County Conservation District adopted Well and Geothermal Standards for private wells and started endorsing a model well ordinance that could be adopted by local municipalities.

In an effort to better understand the quantity of water available in Adams County, different water quantity programs have been created: monthly groundwater levels are being collected by the Conservation District, a volunteer precipitation monitoring program has been established, and the low flow stream levels are being monitored.

Adams County plans containing general policies regarding conservation, water quality, and environmental protection include the following:

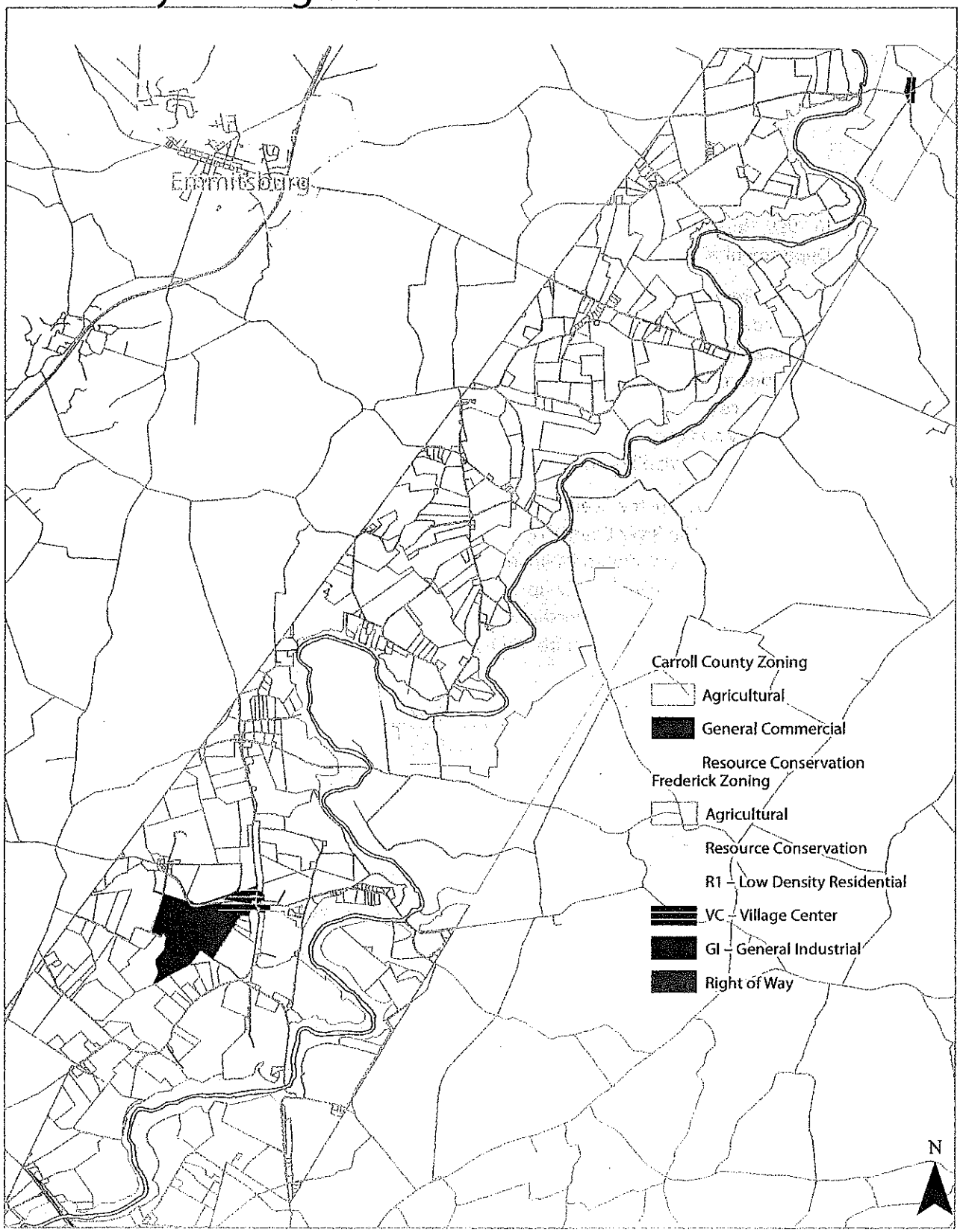
- Adams County Comprehensive Plan (1991)
- Monocacy River Watershed Stormwater Management Plan (2002)
- Adams County Stormwater Management Plan (2012)
- Adams County Greenways Plan (2010)
- Adams County Water Supply and Wellhead Protection Plan (2001)
- Critical Area Resource Plan-Marsh and Rock Creek Watersheds (2012)

In 1999, the Watershed Alliance of Adams County (WAAC) was incorporated into the Pennsylvania Department of State. It is a non-profit organization whose goals are:

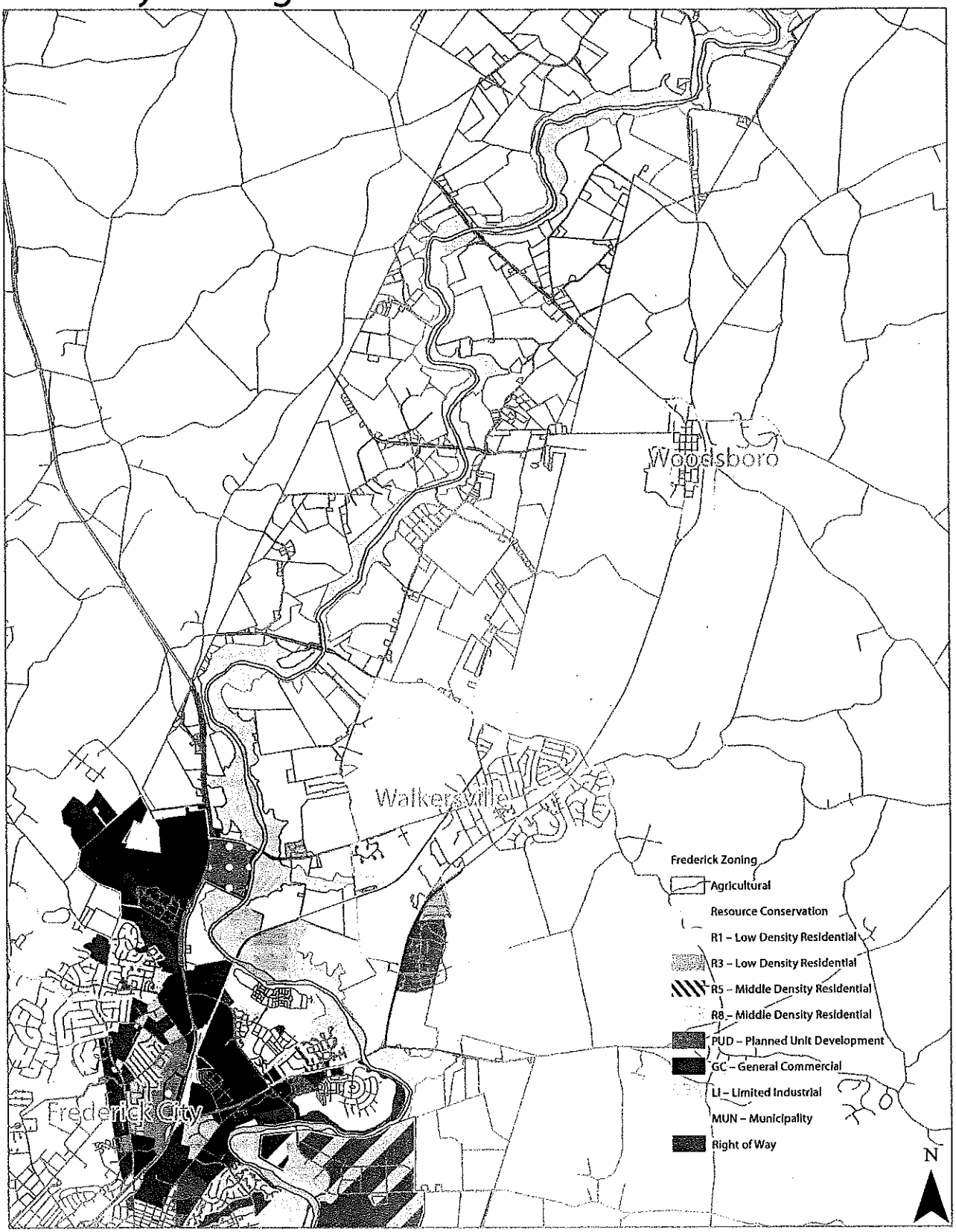
- Help residents better understand the complex watershed issues affecting Adams County
- Encourage sound water management and land use practices that will promote a sustainable watershed resource
- Support a county-wide water monitoring program and database for use for evaluating water resources
- Identify and carry-out watershed improvement projects
- Maintain the viability and sustainability of the WAAC

As previously stated, the Scenic Monocacy River begins with headwater streams in Adams County, Pennsylvania. The River Board's by-laws call for collaboration with Adams County. Early attempts at having ex-officio membership on the River Board by Adams County were not effectively implemented. However, follow-up attempts at reestablishing coordination and more productive communication with the Watershed Alliance of Adams County will be made through development of a joint Action Plan between the River Board and the Watershed Alliance of Adams County.

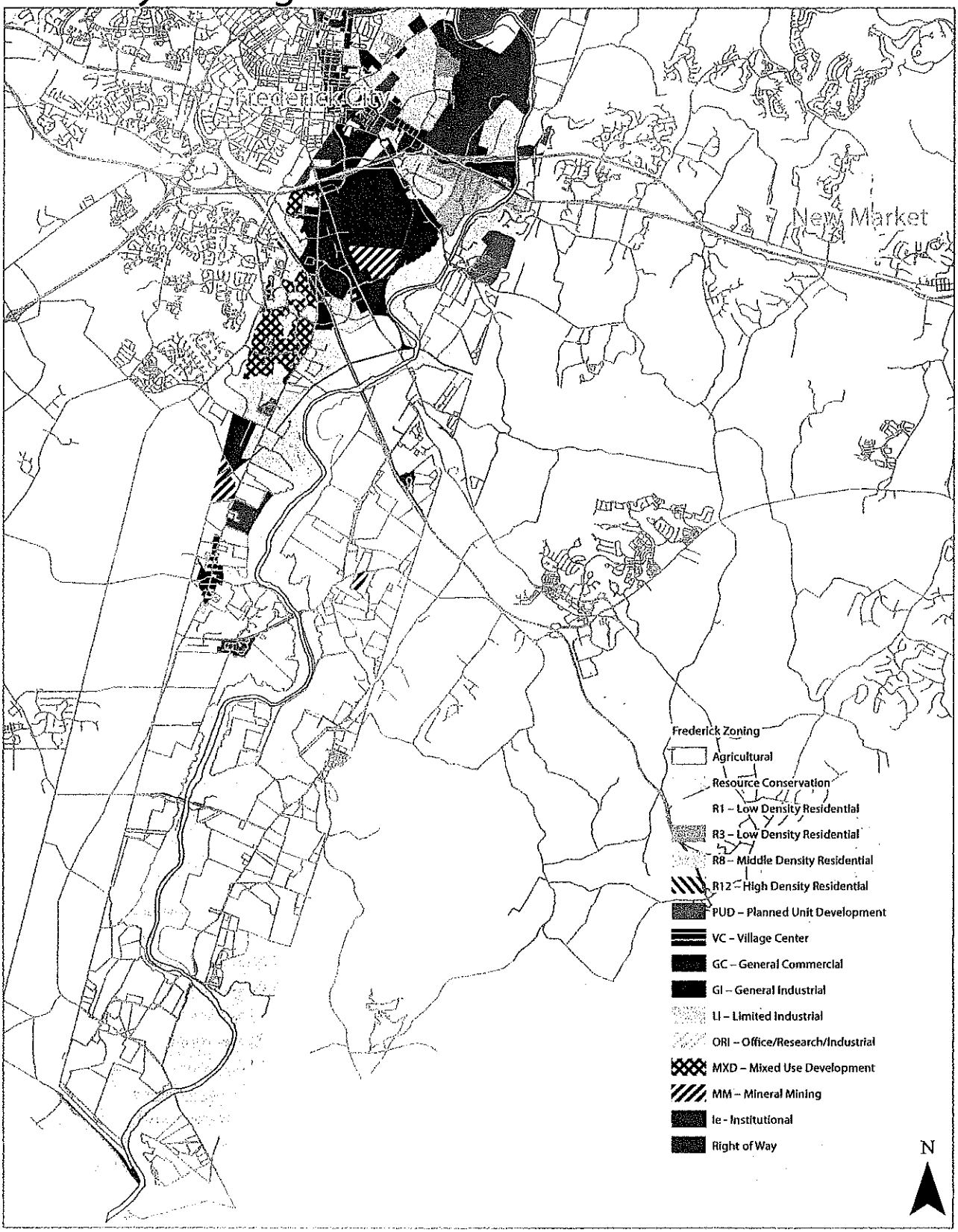
Monocacy Zoning Section 1



Monocacy Zoning Section 2

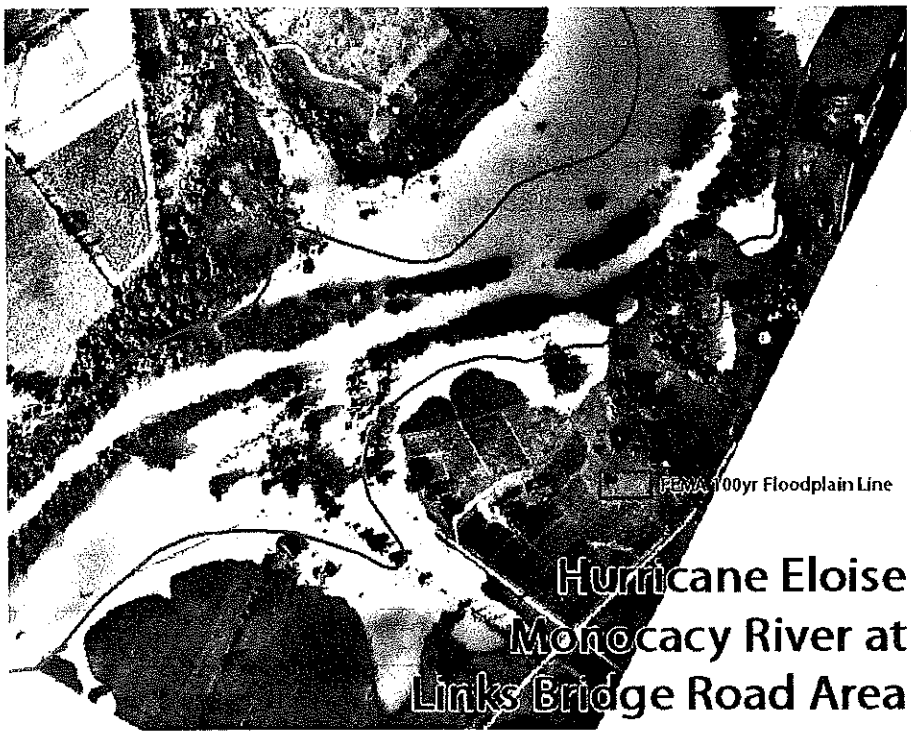


Monocacy Zoning Section 3



Source: Frederick County Division of Planning and Permitting. Carroll County Department of Planning.

rimarily the 100-year floodplain area has the most regulation in terms of onstruction, uses, and activities around a waterway but, as the two accompanying nages of the September 1975 Hurricane Eloise show, land around the River was ıundated beyond the 'boundary' of the FEMA 100-year floodplain (shown by blue ne). Protection of infrastructure, properties, structures as well as the health, safety nd welfare of residents requires resiliency planning with bold and progressive land ıanagement for adaptation to more impactful and altered weather regimes.



Existing River Protection Measures

All of the jurisdictions along the Monocacy River have existing ordinances and measures in place to regulate development and the construction of residential dwellings and all buildings along the River. The effectiveness of the regulations, in protecting the natural resource features adjacent to the River, vary in the different jurisdictions but all provide some basic protections along the River from development.

Frederick County

Floodplain Regulations

The County's floodplain regulations provide a high level of protection along the Monocacy River. The County's Zoning Ordinance regulates development in the FEMA 100-year floodplain, historic floodplain and flooding soils. These regulations apply to all the County's zoning districts and are implemented through the subdivision review process and through the review of construction permits. The County does not permit structures, impervious surfaces, or grading within the FEMA 100-year floodplain. An additional 25-ft. setback for structures is required from the 100-year floodplain boundary.

Waterbody Buffer Ordinance

The County adopted a variable-width waterbody buffer ordinance (within the Zoning Ordinance) in 2008 that applies to all perennial and intermittent streams, the

Monocacy and Potomac Rivers, as well as waterbodies such as Lake Linganore, when land undergoes subdivision in any zoning district. The variable-width setback is determined by the extent and degree of slope along the stream/river and contains widths of 100, 125 or 150 feet from banks of the waterway (streams, rivers) or waterbody (lakes, ponds). Structures and land alterations, with a few exceptions for utilities, roads, etc., are prohibited within the buffer. Development activities, including grading and construction on parcels not subdividing, are subject to a 50-ft. stream/river setback.

Wetland Regulations

Frederick County addresses wetlands and flooding soils (soils with characteristics of temporary inundation of water) through the Floodplain District Regulations in the Zoning Ordinance. The County does not permit development, impervious surfaces, grading or filling in wetlands. A 25-ft. setback for structures is required from all wetlands. Both the Maryland Department of the Environment and the U.S. Army Corps of Engineers are involved in designating wetlands in Frederick County.

Resource Conservation Zoning District

In the case of aquatic resources, the Resource Conservation (RC) zoning district is applied to major streams and rivers and generally follows the FEMA 100-year floodplain boundary. Where there are adjoining forested areas that extend beyond the FEMA floodplain line, the RC zone is extended to encompass those forested areas. The RC zone does permit residential dwellings on existing parcels, but require new subdivision lots to be 10-acres in size. Restrictions in the RC zone prohibit buildings and structures on slopes > 25% and require that habitats of endangered species be identified and be protected from development or disturbance. Forest clearing is limited to an area of 40,000 square feet for each home site. Commercial timber harvest is permitted subject to review and approval by the Frederick County Forestry Conservancy Board. The RC zone also prohibits the construction of new public streets.

Carroll County

Projects in Carroll County that go through the subdivision or site plan development process must comply with Chapter 154 of the Carroll County Code. Included in the code is the definition of a variable stream buffer width. The buffer is a minimum of 50 feet from each stream bank with increases then incorporated based on bank slope and the presence of wetlands. The average bank slope is measured from the edge of stream to a point 100 feet from the edge of stream. Two feet of buffer are added for each one percent of slope. If wetlands or steep slopes greater than 25% are present, their widths are added to the buffer.

Additional water resources restrictions include a 25-ft wetland buffer and a 50-ft pond buffer around the outermost boundaries of a pond.

Projects in Carroll County that go through the subdivision/site plan process must also meet the requirements of Chapter 153 related to floodplains. If floodplain delineation is required by code, floodplains on a proposed site must be shown and any impacts to the floodplains must be shown to not create a rise in the water surface elevation.

Permanent protective easements are then established on the stream buffer areas ('Water Resource Easement') and floodplain areas ('Floodplain Easement') to ensure that riparian areas and aquatic

systems are protected and function to provide their full environmental benefit.

Building permits on pre-existing lots, as defined in Chapter 153 are only reviewed for floodplain encroachment. If construction is proposed to occur within 10 vertical feet from the top of a non-FEMA streambank, a floodplain analysis is required to delineate the floodplain. All proposed construction must stay outside of established floodplains, or 100 feet from edge of stream. No easements are established during a building permit process.

The City of Frederick

Article VII (Floodplain Management) of the Code of the City of Frederick, Section 25-49 (Establishment of Floodplain Zones) and Section 25-50 (Development Regulations in Floodplain Zones) require:

Flood Protection Setbacks

- 100-ft. Flood Protection Setback is required unless modified by the Planning Commission or Planning Department if the applicant demonstrates that it is impossible to allow reasonable development without encroachment into the Flood Protection Setback. It shall extend from the top of the bank of any watercourse delineated as having a floodplain on the floodway map or Flood Insurance Rate Map (FIRM), but in no case shall the setback be required to extend beyond the floodplain boundary.

- 50-ft. Flood Protection Setback is required from the top of the bank of any stream which has no delineated floodplain, unless modified by the Planning Commission or Planning Department.

Unmapped streams

- 50-ft Flood Protection Setback is required from the top of the bank of an unmapped stream may be considered as a floodplain zone in areas where no other data is available.

Wetlands

- 50-ft Wetland Protection Setback. This may be modified by the Planning Commission or Planning Department, if the applicant demonstrates that it is impossible to allow reasonable development without encroachment into the wetlands protection setback area.

Fill shall not be used to create additional lots in the floodplain beyond that which is permitted by Federal and State regulations and flood storage capacity shall be maintained. Encroachments, such as fill, new construction, substantial improvements, and other development shall not be placed in the adopted regulatory floodway unless a Letter of Map Revision from FEMA is obtained.

The Town of Walkersville

Section 28-20, Flood Protection Setback Requirements, of the Walkersville Town Code require:

- A minimum 100 foot flood protection setback shall be maintained from the edge of the banks of any watercourse delineated as having a floodplain on the Floodway Map or Flood Insurance Rate Map (FIRM), except where the setback may extend beyond the floodplain

- A minimum 50 foot flood protection setback shall be maintained from the top of the bank of any stream which has no designated floodplain.

Section 28-21, Subdivision Requirements, of the Walkersville Town Code require:

- To achieve long-term flood damage avoidance and protection of the natural and beneficial floodplain functions, creation of any new flood-prone building sites shall not be permitted in any new subdivisions regardless of size, number of lots, and location.

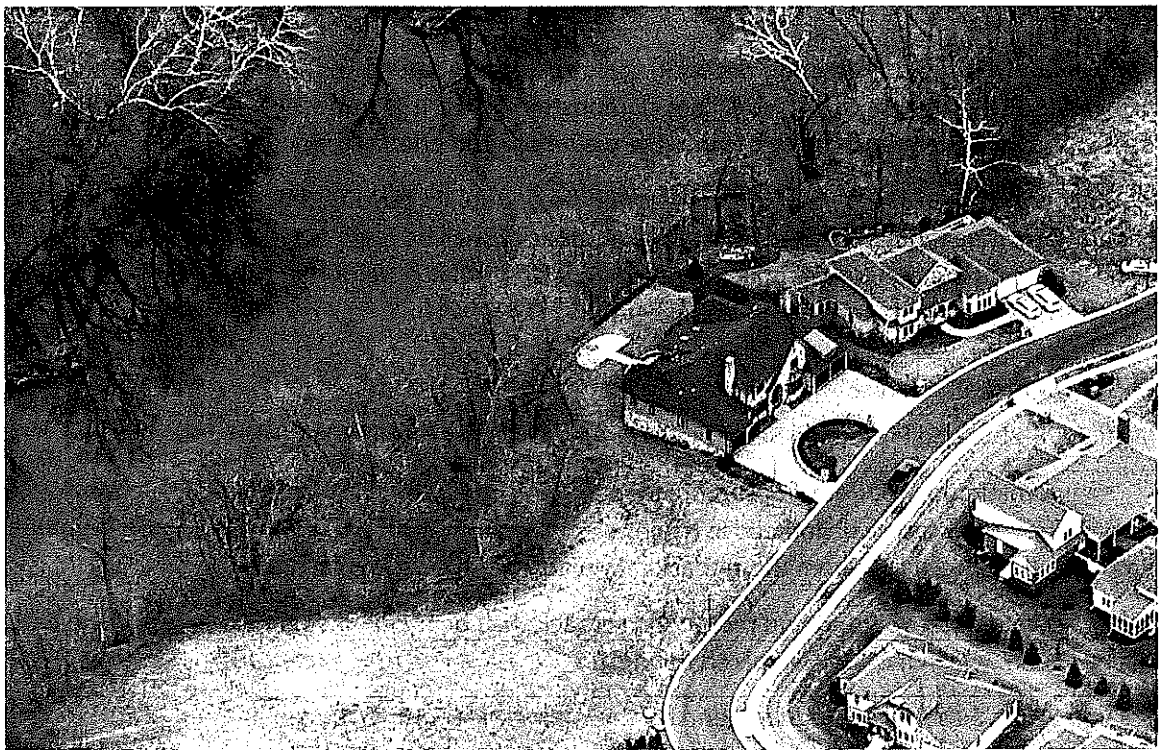
- Within new subdivisions, the floodplain areas and their natural vegetation shall be preserved and dedicated to natural buffer areas, open space, recreation, and similar compatible uses by deed restriction, restrictive covenants, or donation to a land trust. At a minimum, the area preserved shall include the flood protection setback area, and, to the greatest extent possible, other floodplain areas. Steep slopes and forested areas adjacent to watercourses shall also be given high priority for preservation.

Section 88-15 (Zoning-Prohibited Uses in all Districts) of the Walkersville Town Code states:

- No new structure or land development, including parking lots, fill, or excavation operations will be permitted within the annual and HUD/FIA floodplains. This does not prohibit road crossings, water impoundments or the placement of public utility lines. (HUD= U.S. Department of Housing and Urban Development. FIA= Federal Insurance Administration)

The codes from both the City of Frederick and Town of Walkersville expressly state that their stream buffers will not extend beyond the floodplain; their setbacks do not protect additional River-related resources beyond the floodplain of the Monocacy River. This Plan identifies and describes the significant landscape elements, sensitive features and landforms that exist outside of the Monocacy River's floodplain. The floodplain is just one of many environmental resources along the River.

The development patterns along the Monocacy River in the City of Frederick show the result of minimal protection standards for the Monocacy River. From GIS aerial imagery, it is apparent that the City modified its 100-ft flood protection setback along the Monocacy River for major residential projects resulting in some structures just 35 feet from the bank of the Scenic Monocacy River, as shown below.



Recommendations

6-1) *Frederick County and Frederick City should fully support and continue membership in the Potomac River Basin Drinking Water Source Water Protection Partnership and support the work of the Interstate Commission on the Potomac River Basin*

6-2) *The River's jurisdictions should consider the adoption of an official policy of non-support for any future water impoundment on the Monocacy Scenic River*

6-3) *The River's jurisdictions should establish the Monocacy River area as a priority area for obtaining land through acquisition, dedication, or donation for public parkland*

6-4) *When subdivision or development occurs near the River, the River jurisdictions should prioritize the River area for on-site reforestation or afforestation through the Forest Conservation Act*

6-5) *The River jurisdictions should consider amendments to ordinances or policies to create incentives for enhanced conservation of the River area during the development review and approval process*

6-6) *The River Board supports voluntary efforts of property owners to establish 'Forest Banking' easements (areas of new forest or existing forested lands held in reserve) on River front land that can then be sold and used to meet Forest Conservation Act requirements for future development elsewhere*

6-7) *The City of Frederick's and the Town of Walkersville's floodplain and flood protection ordinances should be amended to provide greater protection to floodplain and aquatic resources, similar to the Frederick County Floodplain District regulations*

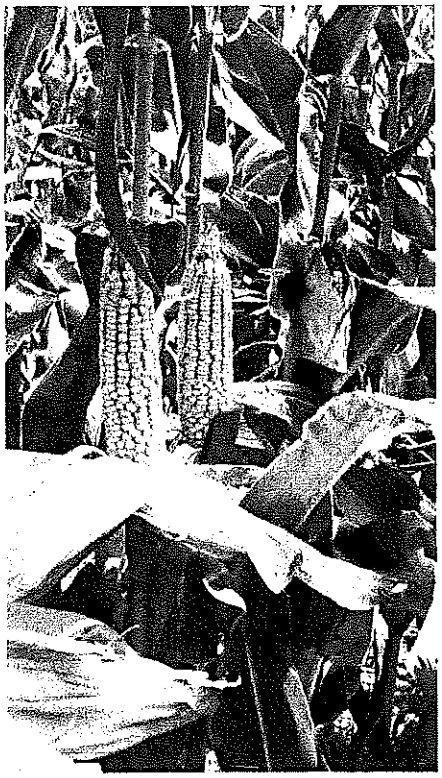
6-8) *The River Board should contact and request that Potomac Edison's utility line right-of-way vegetation management plans include environmentally-sound riparian vegetation management adjacent to the Monocacy River*

6-9) *The City of Frederick's Sustainability Plan should be reviewed by the River Board to ensure the Monocacy River receives greater focus, status, and attention, above what's included in the City's 2010 Comprehensive Plan*

6-10) *The River Board should establish regular communication with the Adams County Watershed Alliance, including development of a join action plan*

[illegible] of our great future
[illegible], if we make ourselves
responsible for that future.

Gifford Pinchot



Both Frederick and Carroll County's history since initial settlement in the mid-1700's has been closely tied to agriculture. The fertile soils, sufficient water, and its favorable climate and topography in both counties were strong attractions to the early settlers. The early agricultural industry was well diversified with grain crops, livestock, vegetables, fruit orchards, and for a short period, tobacco.

Today, Frederick and Carroll County rank very high in the market value of all agricultural products (crops, including nursery and greenhouse, livestock, poultry, and their products) sold in Maryland according to the U.S. Department of Agriculture's 2012 Census of Agriculture. Frederick County was 7th of all Maryland counties with $150,459,000 in market value of agricultural products in 2012, and Carroll County was 10th, with $111,637,000 market value in 2012.

The rural agricultural landscape in the Monocacy River Watershed is part of Frederick's and Carroll's economy, culture, and history. Many of the towns and communities in each county were established to support the surrounding agricultural enterprises. The growth and expansion of agricultural activities also affected the physical landscape of the Monocacy River Watershed through the clearing of forestland, including in the River's floodplain, which is fertile with alluvial deposits from the River—silt, sand, clay, gravel and fine organic matter.

Stewardship

Conservation Practice Standard, Code 391, from the U.S Department of Agriculture, Natural Resources Conservation Service's National Handbook of Conservation Practices, defines a riparian forest buffer as, "An area predominately trees and/or shrubs located adjacent to and up-gradient from watercourses or water bodies," whose purpose includes:

- To create shade to lower or maintain water temperatures to improve habitat for aquatic organisms
- To create or improve riparian habitat and provide a source of detritus and large woody debris

Agroforestry

Agroforestry is the concept of combining trees with agriculture to enhance productivity, profitability, and environmental stewardship. The U.S. Department of Agriculture (USDA) defines Agroforestry as the intentional integration of trees and shrubs into crop and animal farming systems to enhance long-term production of food and other useful products, to protect the soil and water, diversify and expand local economies and provide wildlife habitat.

According to the USDA, there are five (5) widely recognized categories of Agroforestry in the US:

Silvopasture – combining trees with livestock and their forages on one piece of land. The trees provide timber, fruit, or nuts, as well as shade and shelter for livestock and their forages, reducing stress on the animals from hot summer sun, cold winter winds, or a downpour.

Alley cropping – planting crops between rows of trees to provide income while the trees mature. The system can be designed to produce fruits, vegetables, grains, flowers, herbs, bioenergy feedstocks, and more.

Forest farming – growing food, herbal, botanical, or decorative crops under a forest canopy that is managed to provide ideal shade levels as well as other products. It is sometimes called multi-story cropping.

Riparian forest buffers – natural or re-established areas along rivers and streams made up of trees, shrubs, and grasses. These buffers help filter farm runoff while the roots stabilize the banks of streams, rivers, lakes and ponds to prevent erosion. They also support wildlife and can provide another source of income when sustainably harvested.

Windbreaks – these shelter crops, animals, buildings, and soil from wind, snow, dust, and odors. These areas can also support wildlife and sometimes are called shelterbelts, hedgerows or living snow fences.

Some Agroforestry systems with specific applications to floodplains include riparian buffers and filter strips for bank stabilization and water quality protection; windbreaks to stabilize erodible soils; alley cropping for enhanced crop production and protection; as well as tree plantings for fuelwood and wildlife habitat. Agroforestry is implemented for several objectives, including productivity enhancement, profit increase, energy conservation, natural resource conservation, and environmental diversification and modification. (Hershey, 1994)

- To reduce excess amounts of sediment, organic material, nutrients and pesticides in surface runoff and reduce excess nutrients and other chemicals in shallow groundwater flow
- To reduce pesticide drift entering the water body
- To restore riparian plant communities
- To increase carbon storage in plant biomass and soils

The Maryland Department of Agriculture (MDA) includes a list of 28 different Agricultural Best Management Practices (BMPs) and their definitions for use in the State's Watershed Implementation Plan (WIPs) for the Chesapeake Bay Total Maximum Daily Load (TMDL) [see Chapter 9 for a full description of the TMDL and WIPs]. The MDA defines forest buffers as "linear wooded areas along rivers, streams, and shorelines. Forest buffers help filter nutrients, sediments and other pollutants from runoff as well as remove nutrients from groundwater."

See www.mda.maryland.gov/resource_conservation/WIPCountyDocs/bmpdef_pg.pdf

This Plan supports the voluntary establishment, creation, and maintenance of a riparian buffer.

Maryland's Phase II Chesapeake Bay Watershed Implementation Plan (Appendix A, Narrative Strategies to meet Interim

Reduction Targets, October 12, 2012), states that meaningful strategies to reduce nutrient and sediment loads in the agricultural sector will be based on three key areas:

1. Applying effective conservation technologies in the management of agricultural lands
2. Proper management of animal waste and related phosphorus issues
3. Sound use of crop nutrients, including timing and methods of application to maximize crop utilization and minimize potential for nutrient losses

http://www.mde.state.md.us/programs/Water/TMDL/TMDLImplementation/Pages/FINAL_PhaseII_WIPDocument_Main.aspx

Maryland has high implementation rates of conservation practices that help to prevent soil erosion and protect waterways on agricultural lands. In 2015—2016, Frederick County had highest number of contracts for cover crops in Maryland; Carroll County had the 3rd highest number (MACS 2016 Annual Report, Maryland Agricultural Water Quality Cost-Share Program, Maryland Department of Agriculture, Office of Resource Conservation).

Frederick and Carroll Counties also had the largest number of waterway protection projects completed in Maryland in Fiscal Year 2016 through the Conservation Reserve Enhancement Program (CREP), a federal-state partnership that pays landowners to take environmentally-sensitive cropland near waterways out of production and plant buffers, create wetlands, protect highly erodible soil, and establish wildlife habitat (MACS 2016 Annual Report).

Agriculture and the Floodplain

In a presentation at the 1994 Restoration of Aquatic Ecosystems Symposium in St. Paul, Minnesota, Hershey (1994) and others reported that extensive damage to floodplain cropland and the associated agricultural infrastructure from the 1993 Missouri River floods were largely preventable with the strategic placement of trees and with more effective management of opportunities offered by natural stands. The costs for recovering and restoring some agricultural land from debris accumulation, sediment and sand deposition, and scour erosions after the 1993 floods exceeded its market value as cropland.

The strategic use of woody vegetation in floodplain agriculture causes significant reductions in flow velocities, which results in the deposition of suspended particles and trapping of debris (Hershey, 1994). Scour erosion is controlled by the dense mat of intertwined, fibrous roots that reinforce the top foot of soil. Perry (1989), reported that trees develop root systems that can extend horizontal distances up to two times the tree height.

A stream lacking protective buffering

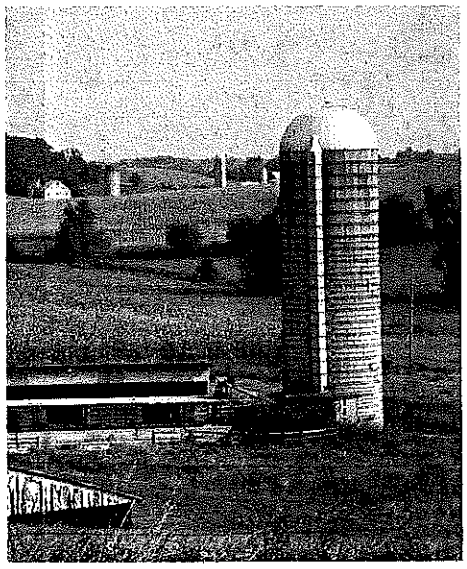
A recent study by Weller et.al. (2011) from the Smithsonian Environmental Research Center in Edgewater, Maryland examined geographic buffer prevalence along water flow pathways connecting cropland to stream with statistical models to test for buffer effects on stream nitrate concentrations

from 321 Chesapeake Bay tributary watersheds. Their research concluded that riparian buffers in the Piedmont watersheds had the highest absolute potential to reduce nitrate concentrations and that restoration of buffer gaps downhill from cropland could achieve significant stream nitrate removal.

Agriculture along the Monocacy River is a prominent land use. According to a recent Frederick County GIS analysis of the entire River, nearly half (41 percent) of the Monocacy River's floodplain is unforested, comprised of cultivated agricultural fields or pasture land, with a high potential for erosion and direct input of sediment and phosphorus into the River. A lack of woody vegetation in the River's floodplain short-circuits the natural flood control, nutrient and energy processing, and habitat provision that a forest riparian landscape provides. Cultivation and grazing in the River's floodplain can result in the washing away of topsoil, crop damage and loss, and challenges for farm machinery after storm events and flooding.

Overbank flooding—flooding that spills stream water onto a vegetated floodplain—can further increase the pollutant load reductions attributed to buffers by treating water coming from the stream. Floodplains are often on 3rd order-and-larger streams, and when overbank flooding happens, the load removal from this process can be larger than buffer retention of loads from uplands (STAC 2012). Restoring floodplain forest can increase retention time on floodplains by increasing roughness from vegetation that influences particle deposition on the floodplain and prevents bank erosion (Belt et al. 2014).

Walkersville Region



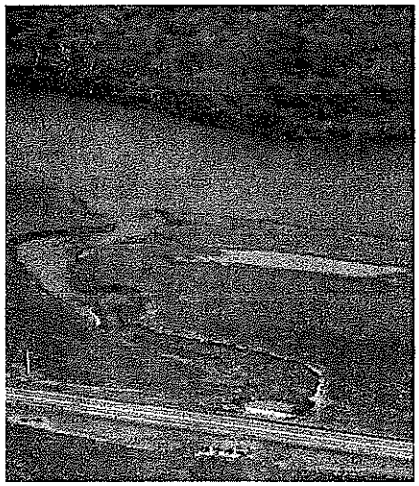
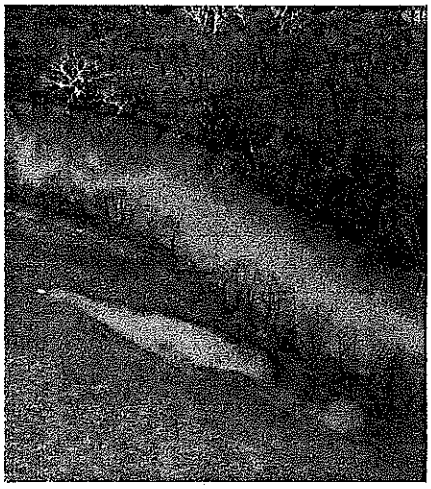
Keymar

The following images depict two very different land management — stewardship — approaches to agriculture in the River's floodplain. The two photographs on the left show operations with minimal or no forest cover along the River with high potential for soil erosion and runoff to enter the Monocacy River. The agricultural operation on the right includes a forest buffer in the River's flat floodplain, providing natural filtration and erosion control, plus habitat for birds and other River inhabitants.

The narrow, one-tree-wide buffer that is present along many sections of the Monocacy River has the potential to be eliminated and wiped-out by the next flood, disease, or pest. This bleak future scenario will result in a less resilient River with no protective and beneficial vegetation for the Scenic

Monocacy River, as well as increasing nutrient and sediment loads to the River.

Increasing the tree canopy on agricultural lands along the River will help reduce direct sediment and phosphorus delivery into the Monocacy River. Because the first step in soil erosion occurs when raindrops hit and loosen the soil, a tree canopy will reduce soil erosion by reducing the number of raindrops that land directly on the ground. Tree leaves substantially reduce the velocity of raindrops before they strike the ground—some rainwater slowly runs down tree trunks to the soil and some evaporates before it reaches the ground. The duff layer in a forested floodplain further aids to slow overland flow of water and to increase infiltration of rainfall. A forested River floodplain enhances the scenic qualities of the Monocacy River.


Agriculturally Productive Buffers

Multi-functional riparian forest buffers provide opportunities for production and economic profit through agricultural diversification by incorporating native fruit, nut, and floral trees and shrubs in areas near streams and rivers. Instead of excluding production, multi-functional riparian buffers offer alternative non-timber forest products that can be harvested for sale or home use, while retaining environmental benefits. The USDA's Non-Timber Forest Product Calculator explores the economic potential and income stream from growing different fruit, nut, and floral trees in a riparian buffer compared to a typical agricultural field: https://nac.unl.edu/tools/ntfp.htm

Examples and resources for Agroforestry in riparian areas are listed below and included in the Appendix of the Plan.

- http://www.uvm.edu/seagrant/sites/default/files/uploads/publication/ag_productive_buffers_-_farmer_handout__fall_2013_small.pdf
- http://smallfarms.cornell.edu/2013/06/28/elderberry-and-beyond-new-options-for-river-lands-in-the-northeast/
- https://nac.unl.edu/documents/workingtrees/infosheets/WTInfoSheet-MultiFunctionalBuffer.pdf

- http://www.dcnr.state.pa.us/cs/groups/public/documents/document/dcnr_20031972.pdf

Articles about multi-functional riparian buffers from the Association for Temperate Agroforestry are listed below:

- http://www.aftaweb.org/127-2016-vol-22/volume-22-no-1-april-2016/204-multifunctional-riparian-forest-buffers-tools-for-merging-conservation-and-production.html
- http://www.aftaweb.org/127-2016-vol-22/volume-22-no-1-april-2016/201-a-multifunctional-riparian-buffer-for-water-quality-and-a-diversified-farm.html

However important agriculture is to our local economy, history, and culture, we all—residents, land owners, businesses, government—have responsibility to be superior stewards of our shared River resource—not just for the drinking water it supplies nor its capacity to assimilate treated wastewater, but the habitat it provides for wildlife, the recreational opportunities, the solitude, and the sense of place and identity the River brings to our community and State. The promotion of our agricultural heritage and its future should also include support and enhancement of the complete River resource—the water, as well as the wetlands, floodplain, forests, habitats, and landforms.

There is a long arc of investment in and appreciation of agriculture in both counties. Below is a listing of the various agricultural land preservation programs in the Monocacy River Watershed.

Frederick County: Existing Preservation Programs/Accomplishments

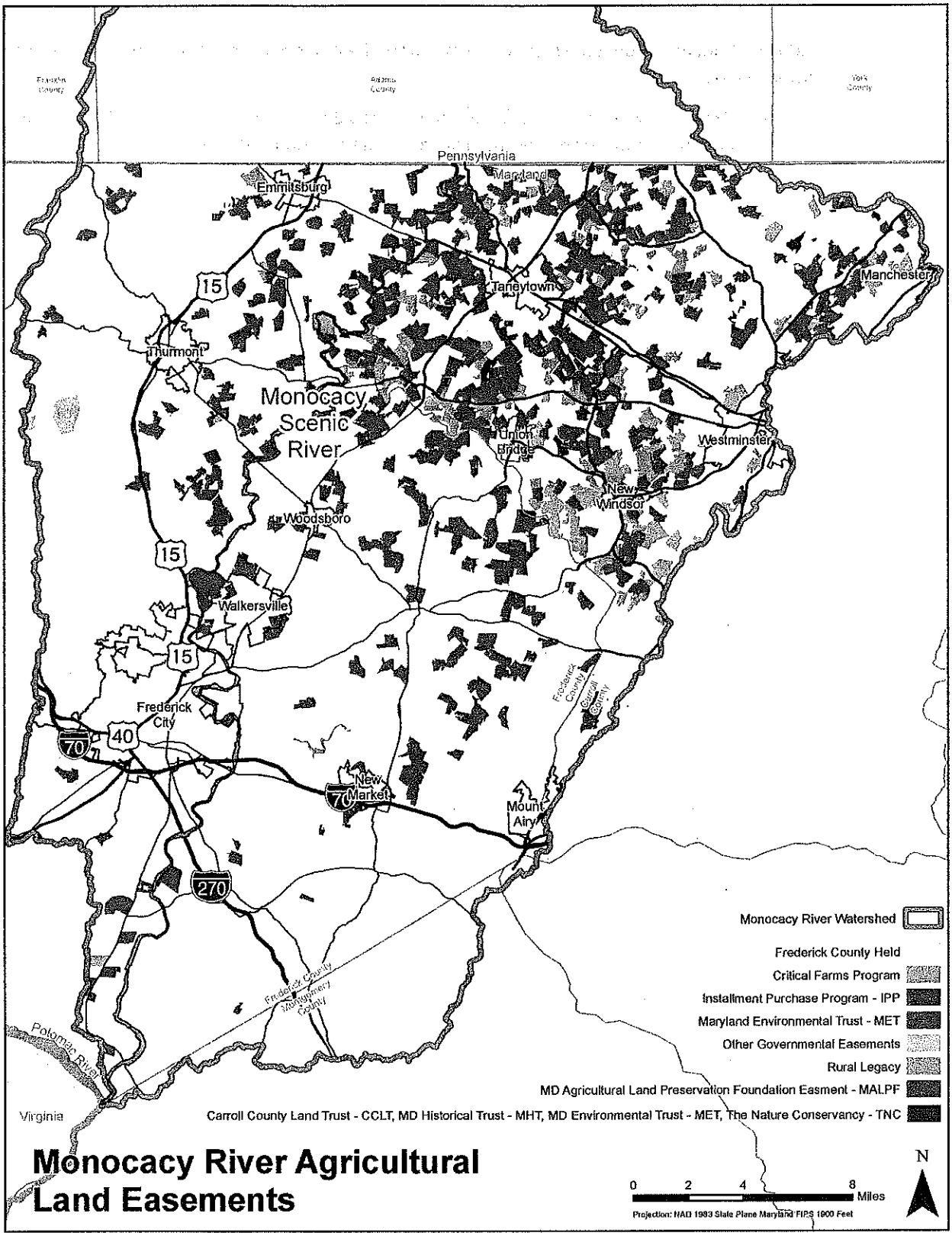
Frederick County has a goal to permanently protect 100,000 acres with various agricultural land preservation programs. In addition, the County has a goal to preserve at least 80 percent of the remaining undeveloped lands within Priority Preservation Areas (PPAs). Priority Preservation Areas are areas in the County designated to receive extra prioritization in the programs, described more fully below. To date, the County has over 52,000 acres permanently preserved and an additional 5,300 acres in temporary preservation agreements. Of that, 36,050 acres fall within the Monocacy watershed. Landowners enrolling in the following programs must have a Soil and Water Conservation Plan. Inspection, follow-up, and revisions to the Soil and Water Conservation Plan are required in order to ensure water quality is addressed and protected along with the agricultural operation. Easements provide legal assurance that intense residential development or other non-agricultural related commercial or industrial uses will not occur.

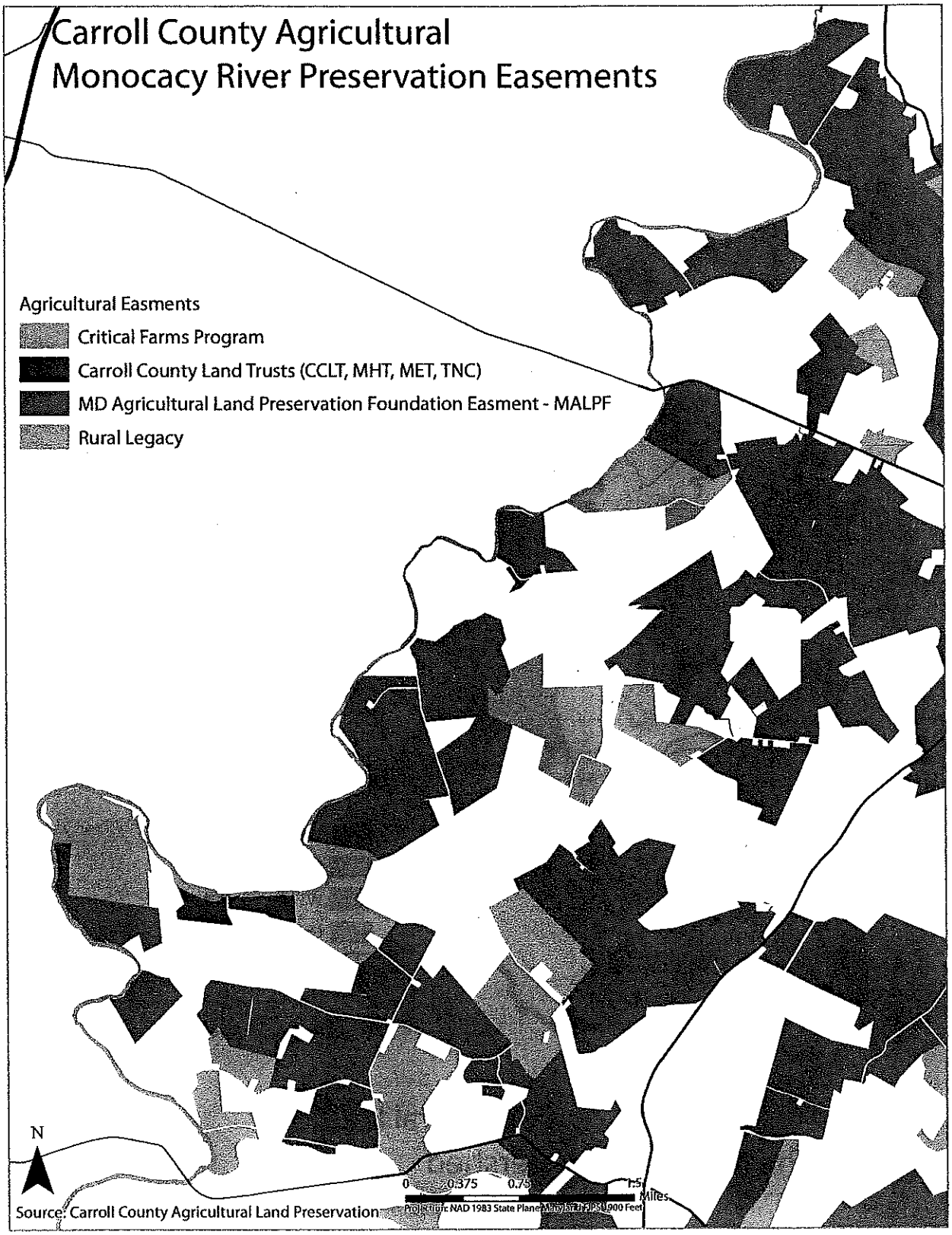
Maryland Agricultural Land Preservation Foundation (MALPF) Program

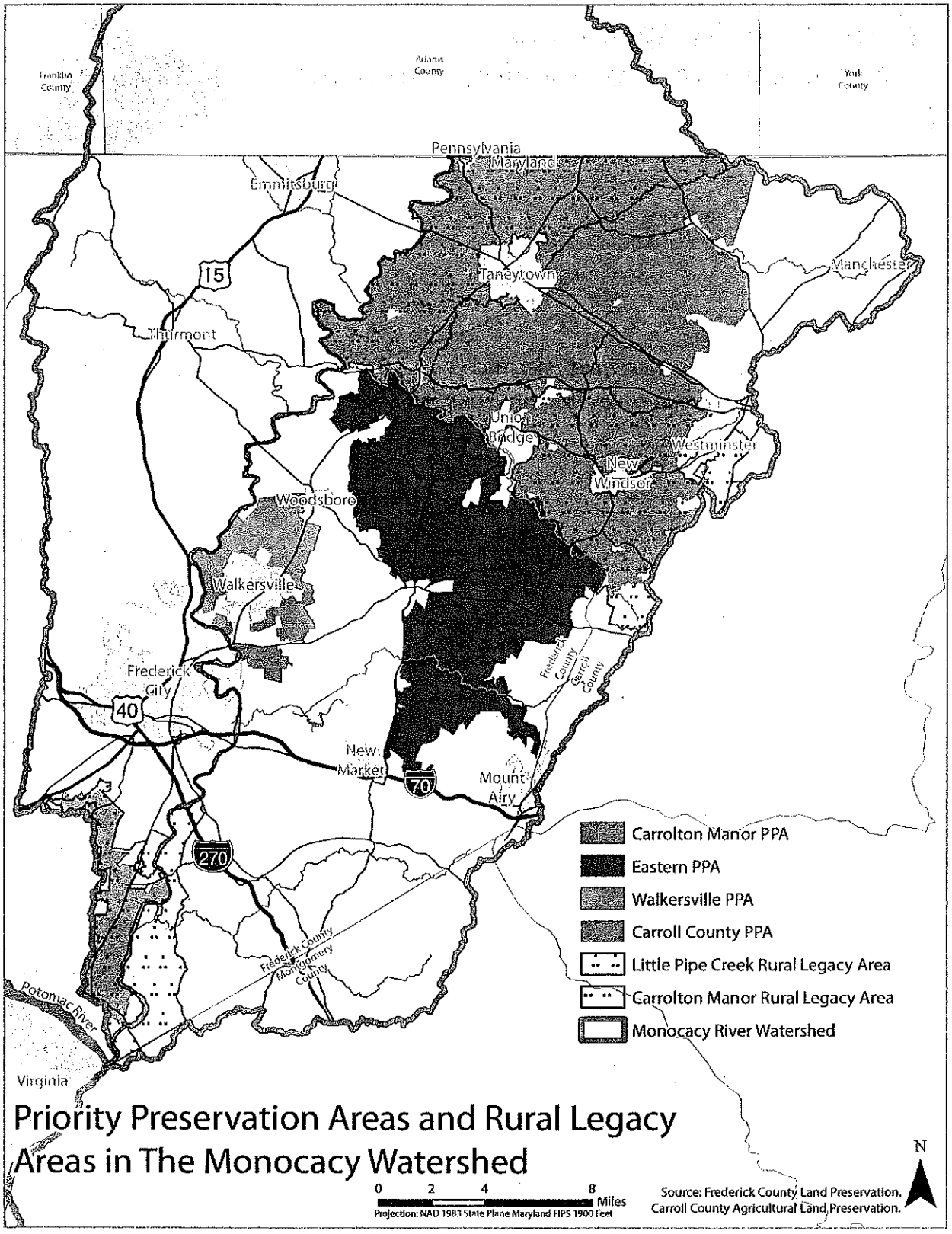
The MALPF is part of the Maryland Department of Agriculture. There are currently 123 farms under easement in a total of 19,141 acres. Of that, 13,607 acres are located within the Monocacy watershed. In addition, there are 51 temporary MALPF District properties that encompass 5,362 acres in Frederick County, of which 4,072 acres are located within the Monocacy watershed. A recent addition to the MALPF easement program is the completion of a Baseline Report prior to easement settlement. This report requires farm inspections to ensure no serious erosion or water quality issue is unaddressed prior to easement settlement.

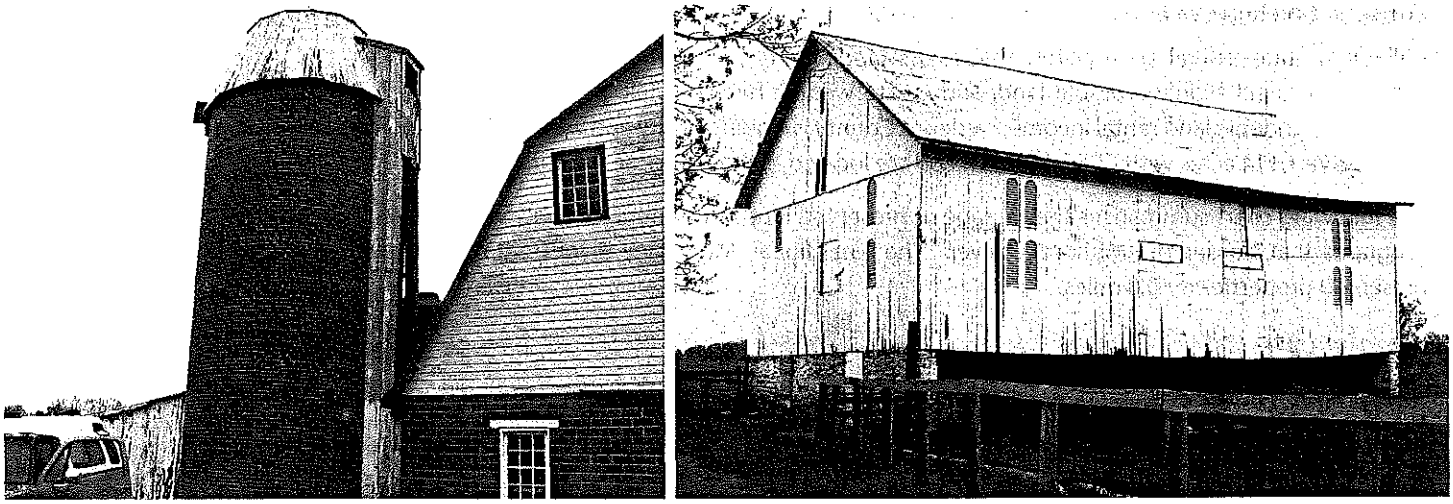
Frederick County Critical Farms Program (FCCFP)

The FCCFP assists farmers in buying farmland. This program was created to help farmers compete with non-farm buyers who often do not have the resources available to farmers to buy farmland. Since 1994 the County has assisted in the acquisition of 37 farm parcels by fulltime farmers on 4,643


Pennsylvania
Maryland
Emmitsburg
Taneytown
Manchester
Thurmont
Monocacy Scenic River
Union Bridge
Westminster
New Windsor
Woodsboro
Walkersville
Frederick City
New Market
Mount Airy
15
70
40
270
Frederick County
Carroll County
Montgomery County
Potomac River
Virginia
Monocacy River Watershed
Frederick County Held
Critical Farms Program
Installment Purchase Program - IPP
Maryland Environmental Trust - MET
Other Governmental Easements
Rural Legacy
MD Agricultural Land Preservation Foundation Easement - MALPF
Carroll County Land Trust - CCLT, MD Historical Trust - MHT, MD Environmental Trust - MET, The Nature Conservancy - TNC
Monocacy River Agricultural Land Easements
0 2 4 8 Miles
N
Projection: NAD 1983 State Plane Maryland FIPS 1900 Feet


Carroll County Agricultural
Monocacy River Preservation Easements
Agricultural Easments
Critical Farms Program
Carroll County Land Trusts (CCLT, MHT, MET, TNC)
MD Agricultural Land Preservation Foundation Easment - MALPF
Rural Legacy
N
0
0.375
0.75
1.5
Miles
Source: Carroll County Agricultural Land Preservation
Projection: NAD 1983 State Plane Maryland FIPS 1900 Feet


Franklin County
Adams County
York County
Pennsylvania
Maryland
Emmitsburg
Taneytown
Manchester
15
Thurmont
Union Bridge
Westminster
New Windsor
Woodsboro
Walkersville
Frederick City
40
Frederick County
Carroll County
New Market
70
Mount Airy
270
Frederick County
Montgomery County
Potomac River
Virginia
Carrolton Manor PPA
Eastern PPA
Walkersville PPA
Carroll County PPA
Little Pipe Creek Rural Legacy Area
Carrolton Manor Rural Legacy Area
Monocacy River Watershed
Priority Preservation Areas and Rural Legacy Areas in The Monocacy Watershed
0 2 4 8 Miles
Projection: NAD 1983 State Plane Maryland FIPS 1900 Feet
Source: Frederick County Land Preservation.
Carroll County Agricultural Land Preservation.
N



New Market region

acres of land. There are currently 1,048 acres of farmland in temporary FCCFP agreements in the Monocacy watershed.

Frederick County Installment Purchase Program (FCIPP)

The FCIPP supplements local land preservation efforts and provides an attractive alternative to existing land preservation programs. It works through the County's Bonding Authority to acquire easements at today's prices and pay for them with a deferred principle payment and annual tax exempt interest payments. The FCIPP has preserved 17,305 acres of land since 2002, of which 11,470 are in the Monocacy watershed.

Rural Legacy Program (RLP)

There are two approved RLP areas in Frederick County; the Mid-Maryland Land Trust Association, Inc (MMLTA) and the Carrollton Manor Land Trust Association (CMLTA). The MMLTA is in the western part of the County along South Mountain extending from U.S. 340 north to Myersville. The CMLTA is in the southern part of the County east of the Catoctin Mountains to the Monocacy River. The RLP has 37 properties covering 4,848 acres put under a preservation easement. Thirty-four of these properties have been preserved in the MMLTA area and the CMLTA area has one easement located in the Monocacy watershed.

Federal Farm and Ranch Protection Program (FFRPP)

The FFRPP makes money available for farmland preservation. Frederick County has made joint application with other Maryland Counties through the Maryland Agricultural Land Preservation Foundation (MALPF) Program. The County has easements on 496 acres that have used FFRPP funds independent of MALPF and are all located within the Monocacy watershed.

Maryland Environmental Trust (MET)

MET is a quasi-governmental organization of the State Department of Natural Resources with the purpose of protecting scenic open spaces including farm and forestland, wildlife habitat, waterfront, unique or rare areas, and historic sites. Since the first easement donated to MET in 1975, there have been 48 properties on 4,398 acres placed under an MET easement in Frederick County. A total of 3,359 easement acres are located within the Monocacy watershed.

Conservation Reserve Enhancement Program (CREP)

CREP is a state-federal partnership that helps landowners plant streamside buffers, establish wetlands, protect highly erodible land, and create wildlife habitat while providing them with a steady, dependable land rental income. Frederick County is a high priority and was awarded funding to preserve 1,114 acres with CREP, of which 689 are located in the Monocacy watershed.

The following chart summarizes the acreage of preserved lands in Frederick County's preservation programs that border the Monocacy River. The total linear, Monocacy River-frontage of these preserved properties is 10.8 miles.

Preservation Program	Acres of Preserved Properties w/ River Frontage
Maryland Agricultural Land Preservation Foundation (MALPF)	1,458
Installment Purchase Program (IPP)	676
Maryland Environmental Trust	626
Conservation Reserve Enhancement Program	64
Frederick County-held Preservation Easement	191

Priority Preservation Areas (PPAs)

House Bill 2 from the 2006 Maryland Legislature required counties seeking state certification of Agricultural Preservation Program to designate PPAs and add a PPA element to their comprehensive plan. A PPA may consist of a single parcel of land, multiple connected parcels of land, or multiple unconnected parcels of land, and include Rural Legacy areas. It shall be capable of supporting profitable agricultural and forestry enterprises; be governed by local policies that stabilize the land base so that development does not convert or compromise agricultural or forest resources; and be large enough to support the kinds of agricultural operations that the county seeks to preserve. Three PPAs as follows are located within the Monocacy watershed.

Carrollton Manor Priority Preservation Area: This PPA contains approximately 19,337 acres located south of Ballenger Creek, east of U. S Route 15, west of the Monocacy River, and extending south to the Potomac River. A small portion is located within the Monocacy watershed near Adamstown.

Walkersville Priority Preservation Area: This PPA encompasses 9,458 acres virtually surrounding the Town of Walkersville and extends west to the Monocacy River and north to the Town of Woodsboro. It includes the highest concentration of prime farmland anywhere in the County and is located entirely within the Monocacy watershed.

Eastern County Priority Preservation Area: This PPA is the largest encompassing 48,427 acres east of MD 75, west of the Carroll County line, and extending south to the Town of New Market. The northern extent is MD 194 north of Ladiesburg. The area includes 9,264 acres of permanently preserved acres, which is over 19 percent of the total land area. This PPA is located entirely within the Monocacy watershed.

Carroll County

Since 1980, Carroll County has been purchasing conservation easements on farmland from

willing sellers with the goal of protecting 100,000 acres from development. For many years, the county operated only the program administered by the State of Maryland. Over time, Carroll adopted additional programs to better meet the specific needs of farm owners, greatly increasing participation. Ag land preservation is accomplished through the use of a deed of easement recorded in the land records that effectively removes development potential from the land. As of June 30, 2015, Carroll County has 66,642 acres under permanent easement countywide.

Carroll County operates three programs that preserve farm and rural lands. These programs have preserved many acres along the Monocacy River and within the Upper Monocacy Drainage Basin:

1. The Carroll County Agricultural Land Preservation Program (ALPP), which has two payment options – lump sum or, the County's leveraged installment purchase that offers 20 years of tax free interest with principal paid at the end.

2. The Critical Farms Program, which Carroll County pioneered, assists applicants in the fee purchase of a farm, paying more than half of the cost or appraised value, and includes preservation via an easement through the state program.

3. The Rural Legacy Program is funded through a state grant program which operates in two designated areas within Carroll County, including the Little Pipe Creek Rural Legacy Area, which includes the Upper Monocacy Drainage Basin.

Upper Monocacy River Drainage Basin / Little Pipe Creek Rural Legacy Area

Carroll County's western boundary includes 86,250 linear feet of the Monocacy River and the interior includes 27,124 acres of the Upper Monocacy River Drainage Basin. Of the Basin acreage, 12,086 acres are in permanent preservation easements.

This region is contained within the Little Pipe Creek Rural Legacy Area. All of the Upper Monocacy Drainage Basin within Carroll County is within Carroll's Priority Preservation Area (PPA), a region designated in response to House Bill 2 enacted during the 2006 Maryland General Assembly. The designation is an incentive to target lands within the area for priority ranking for preservation. The PPA contains approximately 64 percent of the preserved land in Carroll County.

In addition to a very active program for retiring development potential, the Carroll County Ag Land Preservation Program (ALPP) and the Rural Legacy Program also focus on water quality improvement by including permanent stream buffers in conservation easement requirements. Riparian buffers included in easements vary between 25 and 100 feet wide on both sides of streams. Carroll County was the first jurisdiction in Maryland to require stream buffers in a locally-operated and funded agricultural land preservation program. The ALPP also requires Total Resource Management Plans and Forest Stewardship Plans, with requirements for implementation.

Lower Monocacy Drainage Basin / Preserved Acres

The Lower Monocacy Drainage Basin that lies within Carroll County contains 5,463 acres. It lies in close proximity to the municipality of Mount Airy and has been significantly fragmented by residential development. However, 546 acres have been preserved in a block within this basin region and some large parcels still remain.

The following chart summarizes the acreage of preserved lands in Carroll County's preservation programs that border the Monocacy River. The total linear, Monocacy River-frontage of these preserved properties is 9.7 miles.

Preservation Program	Acres of Preserved Properties w/ River Frontage
Maryland Agricultural Land Preservation Foundation (MALPF)	1,548
Carroll County Agricultural Land Preservation Program (CALPP)	534
Carroll County Land Trust	78
Rural Legacy	94

Recommendations

7-1) Frederick and Carroll Counties should continue to employ a wide range of economic incentives, financial aid, and technical assistance for landowners to voluntarily protect, maintain, and restore the forestlands along the Monocacy River.

7-2) Consider the establishment of a Monocacy River Land Preservation Initiative involving the Frederick County IPP Program and the Frederick County Forest Easement Fee-in-Lieu Program, whereby a landowner is paid for a permanent protective easement on land along the Monocacy River and its tributaries with the remainder of the farmland enrolling simultaneously in the Frederick County IPP. This would incentivize permanent protection and preservation of both agricultural lands along the Monocacy River, and grant additional ranking points in the Frederick County IPP to property owners willing to collaborate with these programs. Evaluate the potential for a similar collaborative program involving the MALPF program in Frederick County and the Frederick County Forest Easement Fee-in-Lieu Program.

7-3) All River jurisdictions should advocate and educate the community on the benefits of the creation of agricultural buffers along the Monocacy River, consistent with state guidelines, and utilize funding to create these voluntary buffers by utlitizing various existing programs (Conservation Reserve Program {CRP}, Conservation Reserve Enhancement Program {CREP}, Environmental Quality Incentives Program {EQIP}, and the Conservation Stewardship Program {CSP}).

7-4) Both Frederick and Carroll Counties should collaborate with the USDA's Natural Resource Conservation Service (NRCS) and the local Soil Conservation Districts (SCDs) to initiate and help fun a pilot program with a willing landowner to design and implement Agro-forestry systems to increase environmental resilience and protection and maintain productive agricultural operations in the Monocacy River's floodplain

7-5) Both Frederick and Carroll Counties should consider partnering with the local SCDs and the USDA's NRCS to engage a farmer in the Agricultural Preservation Program in a pilot project to install the following innovative BMPs along the Monocacy River or within the watershed to reduce nitrogen, phosphorus, and sediment inputs:

Saturated Buffers

Riparian buffers intercept surface water (and some shallow groundwater) when it runs off the land, transforming—denitrifying—nitrate to harmless nitrogen gas, and capturing phosphorus and sediment coming off fields. However, the use of below-grade drainage tiles on agricultural fields bypasses these land practices and can introduce nitrogen and phosphorus directly into streams and the Monocacy River. Water from drain tiles can be diverted to a 'saturated buffer' which stays

wetter than a typical riparian buffer and operates more like natural wetlands that provides the right environment for microbes to digest (denitrify) much of the nitrate in the drain tile water. The use of saturated buffers was developed at the National Laboratory for Agriculture and the Environment in Ames, Iowa, but has potential for application in the Monocacy River Watershed to help achieve Chesapeake Bay TMDL nutrient and sediment reduction requirements.

Bioreactors

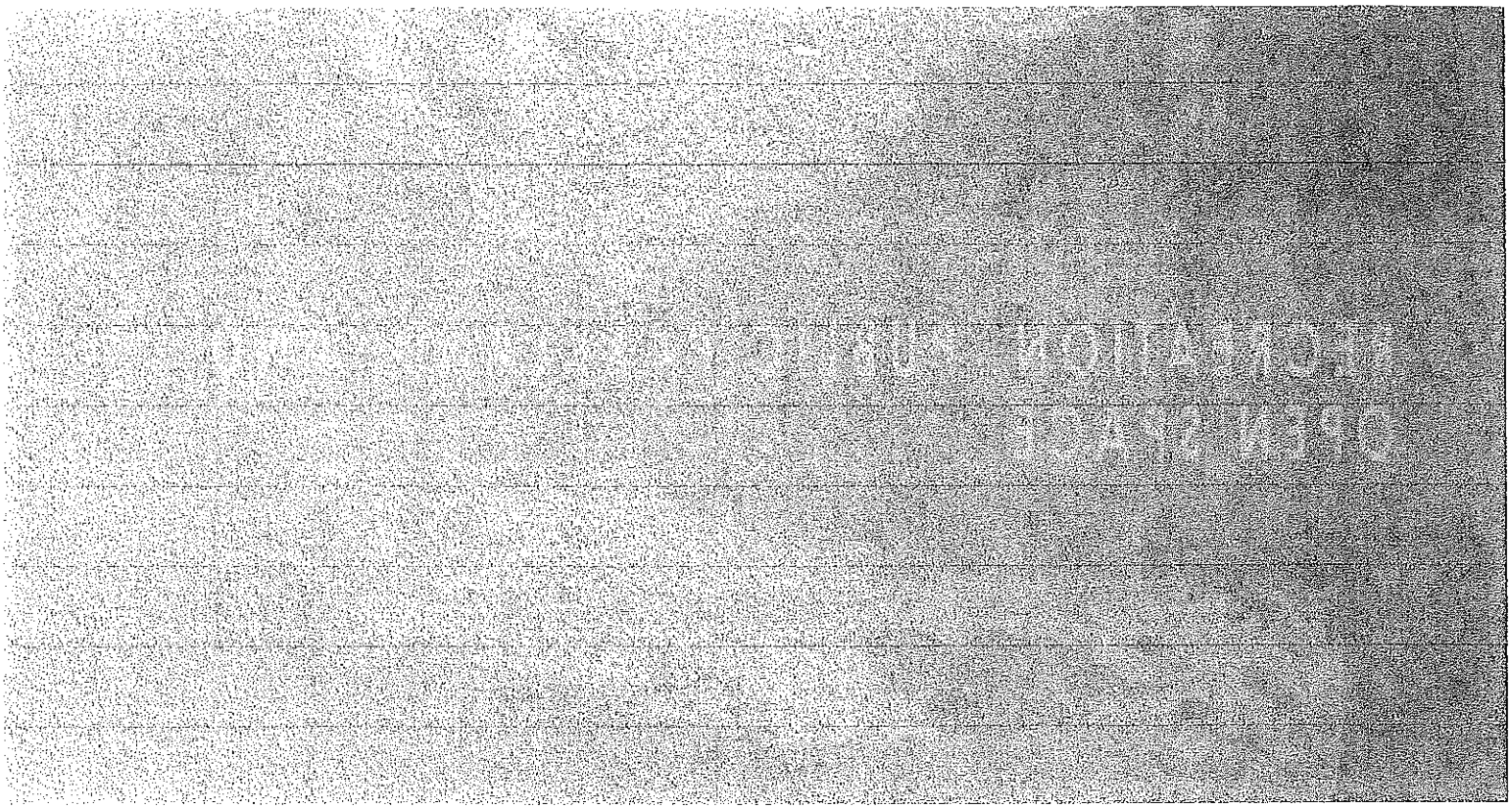
These devices have been successfully used on Maryland's Eastern Shore in the Choptank River Watershed and in New York's Upper Susquehanna and Finger Lakes Watersheds to reduce the nitrogen levels of water from agricultural lands. Field water is diverted or pumped to a pit filled with wood chips, which mimic the conditions in a waste water treatment plant, providing the medium for bacteria to convert the nitrate from fertilizers or manure into harmless nitrogen gas. The water then flows out of the pit and has significantly reduced nitrogen content. Bioreactors help to recreate the natural process that would have occurred on land that is more suited to be a fallow wetland, but has been engineered for agriculture.

7-6) Include in Frederick County's land preservation program inspection reports a review that determines and monitors whether required soil and water conservation plans on farms along the Monocacy River are being executed and fully implemented. This will help ensure that farms with preservation easements along the Monocacy River and its associated tributaries are implementing the conservation practices recommended to them by local experts and professionals working in the water quality and agricultural arenas.

7-7) Frederick and Carroll Counties should partner with the University of Maryland Cooperative Extension, the University of Maryland's Department of Agricultural and Resource Economics, the US Forest Service, and the Alliance for the Chesapeake Bay to bring the program, "Family Forest and Agriculture Legacy Planning" to Carroll and Frederick Counties. "Legacy Planning" is a process that involves family members in discussions and decisions about current and future use, management, preservation, and overall goals related to land management, estate transfer, and inheritance.

7-8) Promote the CREP permanent easement program through targeted mailing outreach to Monocacy River-front landlowners in Frederick County, with initial focus on lands within the MD-DNR's Ecologically Significant Areas (ESAs).

7-9) Establish a premium payment for Monocacy River-front landowners in Frederick County who voluntarily establish new forest plantings along the River through the CREP permanent easement program, to further incentivize enrollment in CREP.



I went to the woods because I wished to live deliberately, to front only the essential facts of life, and see if I could not learn what it had to teach, and not, when I came to die, discover that I had not lived.

Henry David Thoreau

RECREATION, PUBLIC PARKLAND, AND OPEN SPACE

View from the Monocacy National Battlefield

Recreation and the World Outdoors

Research has found that exposure to and connections with nature provide many benefits to humans, such as well-being, calmness, and mental clarity. The concept of Biophilia, advanced by German psychologist Erich Fromm and more recently by biologist E.O. Wilson, is defined as humans' innate need to affiliate with other life such as plants and animals, and our inherent desire and liking to be near nature, based on the fact that we have spent the majority of our evolutionary history closely connected to nature.

The advancement and proliferation of technology has created a 'wired and connected' world, where people—even children---are glued to electronic devices and media for hours every day. This results in less physical activity, higher obesity rates, and less time exploring and discovering the natural world. Ecologists, naturalists, and environmental educators refer to this as Nature Deficit Disorder, a term first used by Richard Louv in his 2005 book, *Last Child in the Woods*, which describes general societal alienation from nature, and the hypothesis that it could possibly result in behavioral problems. "Forest therapy" and "forest bathing" are concepts now being promoted by therapists and health professionals to enable people to reduce stress while reconnecting with the natural world.

In 2008, the State of Maryland created the Partnership for Children in Nature to ensure that "all Maryland young people have the opportunity to learn about their environment, connect with the natural world, and grow to become good environmental stewards." The Partnership Plan resulted in a change to State law that now requires every high school student to complete a designated course of study on environmental literacy (COMAR 13A.03.02).

Parks and Policy

As the conversion and development of land to meet human needs for housing, employment, and services continue, so will the need grow for acquisition of land for public access, enjoyment, preservation, and living resource vitality. Sustained and continued focus on planning and funding for public open space, public parkland, and Monocacy River access is vitally important for a high quality living environment, legal requirements for improvementsto water quality, and to meet the recreational needs of increasing populations in both Frederick and Carroll Counties.

Public River Access

There are many federal, state, and local public lands in the Monocacy River Watershed and along the Monocacy River, offering a wide variety of amenities, from active recreational fields to natural areas for resource protection. However, some of the recreational and scenic attractions in part of the Monocacy River are marred by trash, tires, and incompatible land uses adjacent to the River. This River Plan recognizes the benefit of public parkland, recreation, and open space. However, most of the land adjacent to the Monocacy River is privately owned, and with increased public access to the River comes additional concerns of environmental risk to the River, as well as potential trespass and security risks for River-front landowners and residents.

Notable, large River-front public parkland or open space includes the Monocacy National Battlefield and the Chesapeake and Ohio National Park (National Park Service), the Monocacy Natural Resource Management Area (Maryland Dept. of Natural Resource), Pinecliff Park (Frederick County), and Rivermist Park (City of Frederick).

A paddling adventure on the Monocacy

Rivermist Park in the City of Frederick

Monocacy River-front parkland is not only intended to serve as recreational and aesthetic amenities to residents and visitors, but in some circumstances, is intended to act as part of larger conservation efforts for natural resource protection, which can address water quality protection and supply, flood hazard reduction, aquifer recharge, wildlife habitat preservation, and erosion control. This Plan supports and encourages the development of public River-front parkland in such a way that balances the provision of active and passive recreational amenities, opportunities for River access, and the enhancement or restoration of the natural environment.

The following page illustrates the numerous public parklands, public open space, and other publicly-accessible lands that exist in the Monocacy River Watershed.

The State of Maryland, Frederick County, and Carroll County all have numerous adopted goals, policies, and action recommendations for the provision of parkland, recreation facilities and amenities, and open space protection. For example, the 2012 Maryland Land Preservation, Parks, and Recreation Plan contains overall state goals to:

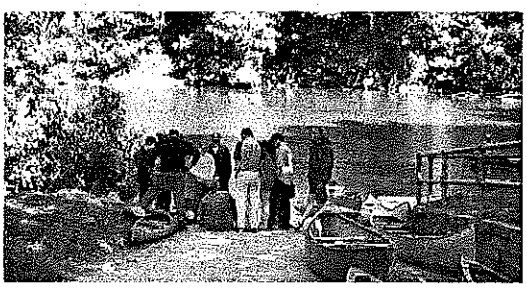
1. Make a variety of quality recreational environments and opportunities readily accessible to all of its citizens, and thereby contribute to their physical and mental well-being
2. Recognize and strategically use parks and recreation facilities as amenities to make communities,

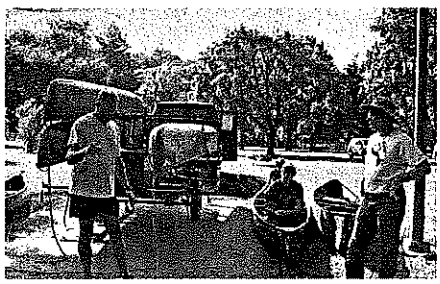
counties, and the State more desirable places to live, work, and visit

3. Use State investment in parks, recreation, and open space to complement and mutually support the broader goals and objectives of local comprehensive/master plans
4. To the greatest degree feasible, ensure that recreational land and facilities for local populations are conveniently located relative to population centers, are accessible without reliance on the automobile, and help to protect natural open spaces and resources
5. Continue to protect recreational open space and resource land at a rate that equals or exceeds the rate at which land is developed at a statewide level

Frederick County

Frederick County's 2018 Bikeways and Trails Plan contains a recommendation for a trail along the Monocacy River. While this Plan supports the concept of outdoor recreation and close-up experiences with the River that a trail would provide, the establishment of trails and paths along the River does not align with the Maryland Wild & Scenic Rivers Act, and is not supported by the Monocacy Scenic River Citizens' Advisory Board.





Carroll County

County Parkland Goal:

Provide an affordable, coordinated, and comprehensive system of public and private parks, recreational facilities and programs, and open space that will meet the active and passive recreation needs of residents and enhance community design, identity, and vitality.

Carroll County Parkland Policies and Recommendations:

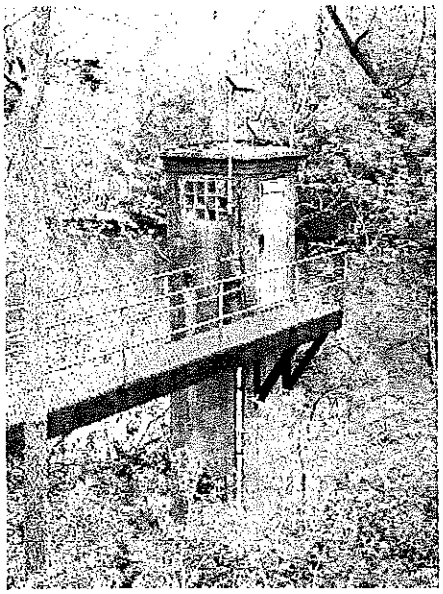
- Fund the majority of additional park facilities through impact fees, Program Open Space funds, grants, and other non-general fund sources
- Continue to support passive recreational opportunities for the conservation reservoir watersheds and wellhead protection areas
- Continue to support park and recreational opportunities in conjunction with school facilities' recreational functions

River Definitions (USGS)

Gauging Station--a site on a stream, lake, reservoir or other body of water where observations and hydrologic data are obtained. The U.S. Geological Survey measures stream discharge at gauging stations.

Gage Height--the height of the water surface above the gage datum (zero point). Gage height is often used interchangeably with the more general term, stage, although gage height is more appropriate when used with a gage reading.

Cubic Feet per Second (cfs)--a rate of the flow in streams and rivers equal to a volume of water one foot high and one foot wide flowing a distance of one foot in one second. One "cfs" is equal to 7.48 gallons of water flowing each second. As an example, if your car's gas tank is 2 feet by 1 foot by 1 foot (2 cubic feet), then gas flowing at a rate of 1 cubic foot/second would fill the tank in two seconds.



- Continue to support the creation of open space opportunities

Carroll County Parkland Recommendations:

- Provide connections between proposed and existing parks and open space and adjoining development, whenever possible
- Identify recreation sites across the county which can meet the projected needs of the local community
- Support recreation sites across the county which can meet the projected needs of the local community as identified in the 2012 Land Preservation, Parkland, and Recreation Plan
- Support the goals, objectives, and recommendations on the 2012 Carroll County Land Preservation, Parkland, and Recreation Plan

Frederick City

The City of Frederick has secured land along the Monocacy River for trails, open space, river access, public parkland, and forest protection. Major City policies for parkland and recreation include the following:

- Continue to identify opportunities for additional parks and open space
- Expand the City's trail network to improve pedestrian and bicycle access to parks and regional trails
- Collaborate with Frederick County and other agencies to enhance parks and recreational facilities for the City's residents

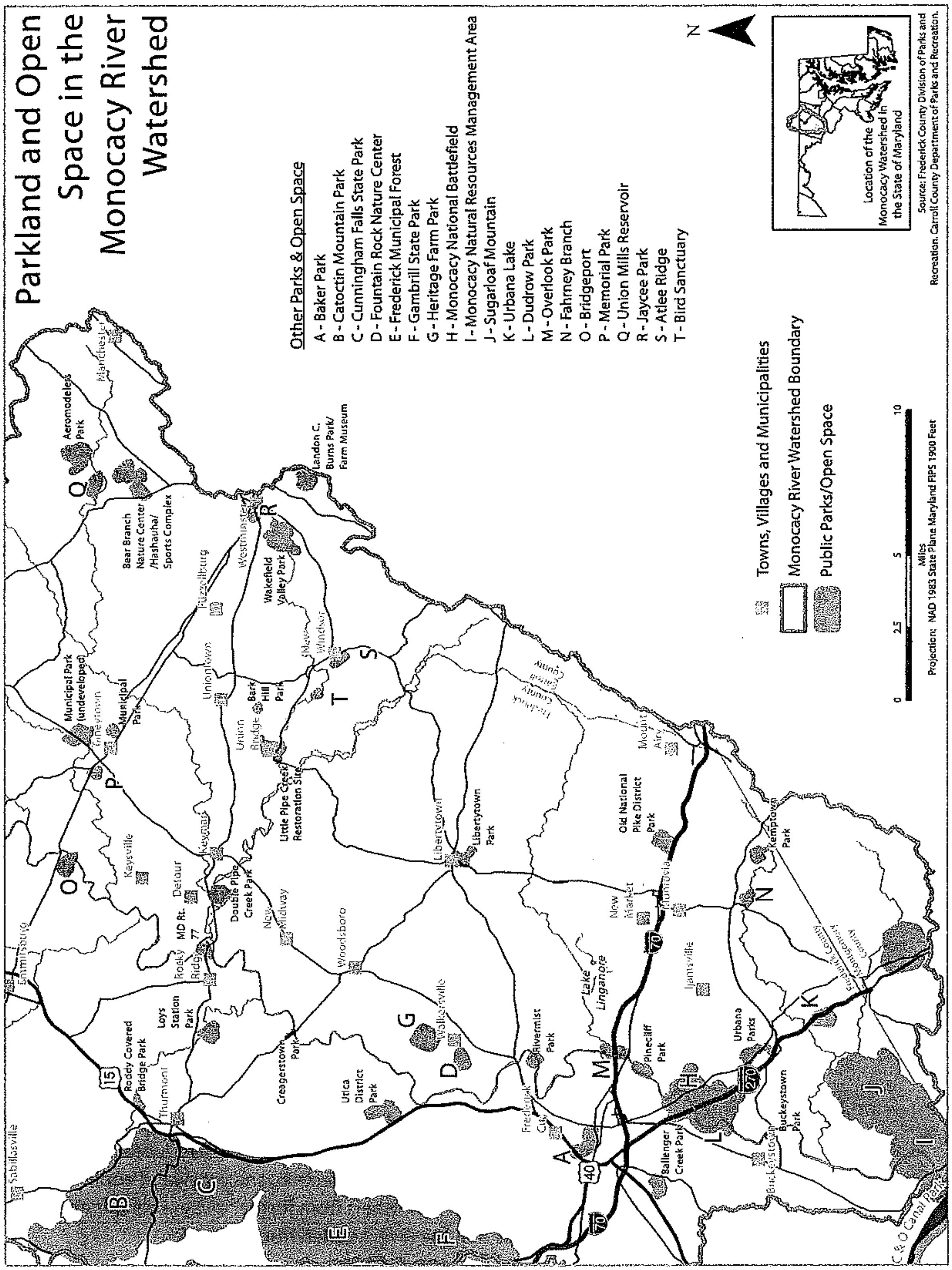
Take Me to The River

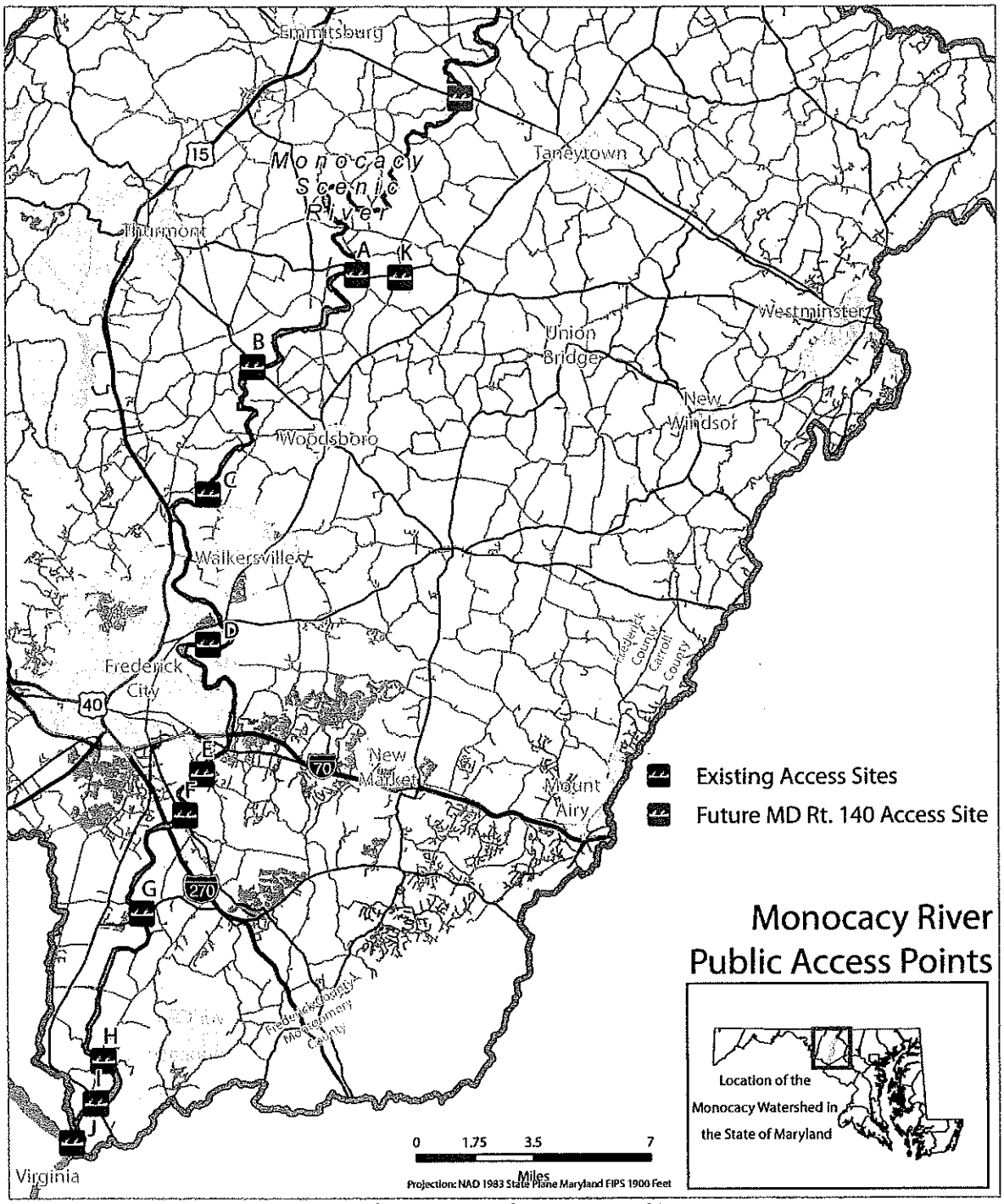
To implement Presidential Executive Order 13508, Chesapeake Bay Protection and Restoration, issued by President Obama on May 12, 2009, the ensuing 2010 Federal Strategy for Protecting and Restoring the Chesapeake Bay Watershed contains a goal of conserving land and increasing public access, with a 'Public Access Outcome' of increasing public access to the Bay and its tributaries by adding 300 new public access sites by 2025.

Communities that have major waterways or waterbodies are more rare than common, and possess opportunities to promote and celebrate these unique natural assets for the community to experience. Monocacy River recreation and related tourism provide enjoyment, well-being, and socio-economic activity in Frederick and Carroll Counties.

From fishing, canoeing, kayaking, birding, and swimming, the Monocacy River offers multiple outdoor recreational options. The River's peaceful serenity also promotes silent contemplation, reflection, and renewal. People—both those who live near the River and others from further away—benefit and gain from the opportunities that the River's varied resources offer.

There are ten public access sites along the Monocacy River, including several


Parkland and Open Space in the Monocacy River Watershed
Other Parks & Open Space
A - Baker Park
B - Catoctin Mountain Park
C - Cunningham Falls State Park
D - Fountain Rock Nature Center
E - Frederick Municipal Forest
F - Gambrill State Park
G - Heritage Farm Park
H - Monocacy National Battlefield
I - Monocacy Natural Resources Management Area
J - Sugarloaf Mountain
K - Urbana Lake
L - Dudrow Park
M - Overlook Park
N - Fahrney Branch
O - Bridgeport
P - Memorial Park
Q - Union Mills Reservoir
R - Jaycee Park
S - Atlee Ridge
T - Bird Sanctuary
Towns, Villages and Municipalities
Monocacy River Watershed Boundary
Public Parks/Open Space
0
2.5
5
10
Miles
Projection: NAD 1983 State Plane Maryland FIPS 1900 Feet
N
Location of the Monocacy Watershed in the State of Maryland
Source: Frederick County Division of Parks and Recreation. Carroll County Department of Parks and Recreation.
Aeromodelers Park
Bear Branch Nature Center /Hashawha/ Sports Complex
Landon C. Burns Park/ Farm Museum
Wakefield Valley Park
Westminster
Manchester
Municipal Park (undeveloped)
Municipal Park
Taneytown
Uniontown
Union Bridge
Bark Hill Park
New Windsor
Little Pipe Creek Restoration Site
Keysville
Detour
Keymar
Double Pipe Creek Park
MD Rt. 77
Rocky Ridge
Emmitsburg
New Midway
Woodsboro
Libertytown
Libertytown Park
Old National Pike District Park
Mount Airy
New Market
Monrovia
Kemptown Park
Lake Linganore
Ijamsville
Walkersville
Rivermist Park
Creagerstown Park
Utica District Park
Loys Station Park
Roddy Covered Bridge Park
Thurmont
Sabillasville
Frederick City
Pinecliff Park
Urbana Parks
Ballenger Creek Park
Buckeystown Park
Buckeystown
C & O Canal Park
15
40
70
270



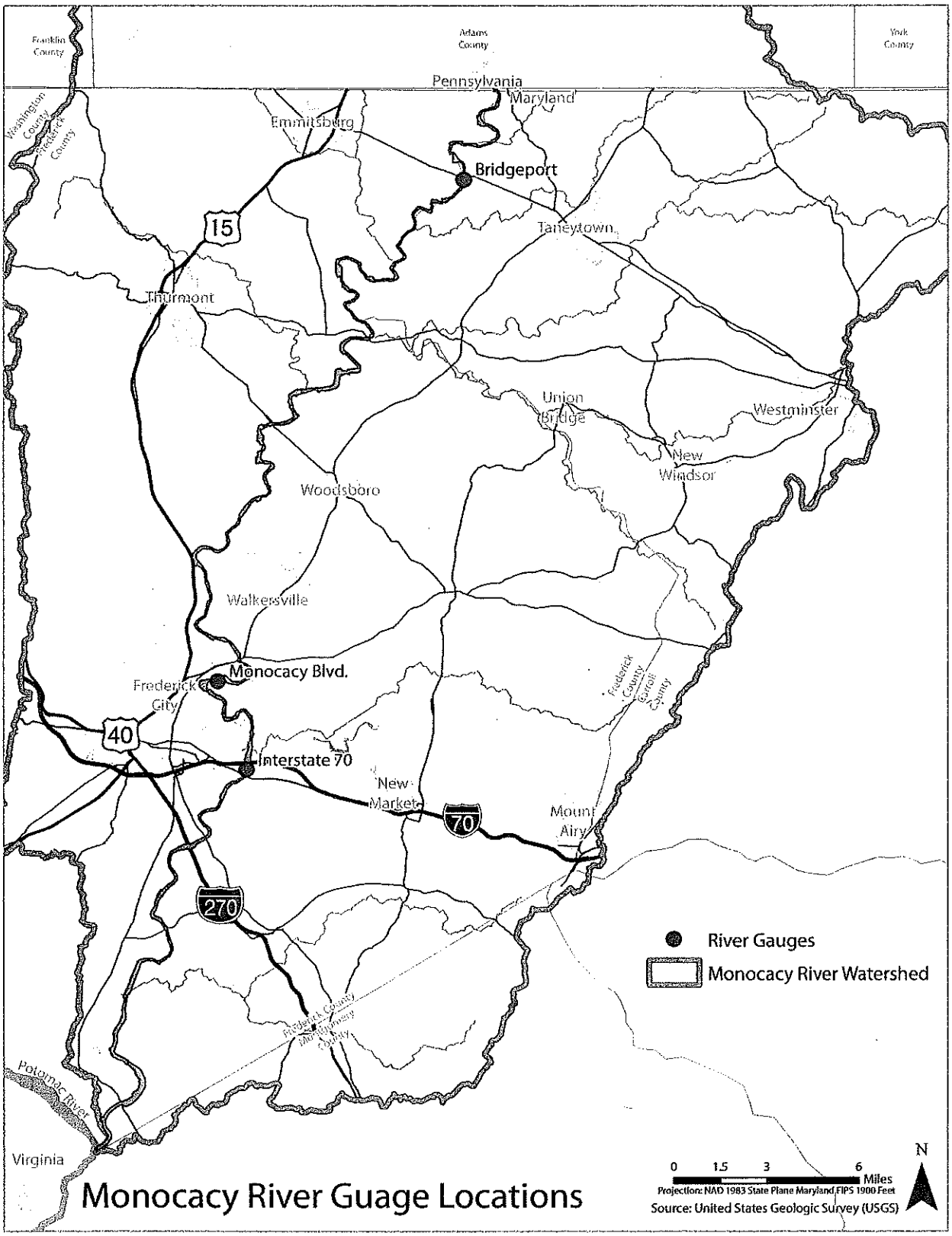
A. MD Rt. 77 River Access (41.7 miles)
B. Creagerstown Park Penterra Manor Lane at Rt. 550 (35.4 miles)
C. Devilbiss Bridge Road (29.9 miles)
D. Monocacy Boulevard (22.3 miles)
E. Pinecliff Park Off Reichs Ford Road (15.7 miles)
F. Monocacy National Battlefield MD Rt. 355 (13.9 miles)
(River access is approximately 900 ft. from parking lot and utilizes a boardwalk and natural surface path to reach the river)

Mileage From The Potomac River

G. Buckeystown Park Michaels Mill Road and MD Rt. 80 (9.6 miles)
H. Park Mills Road (3.8 miles)
I. MD Rt.28 (1.9 miles)
J. C&O Canal Park near Monocacy Aqueduct
Mouth of Monocacy Road, Dickerson MD (.3 miles)
K. Double Pipe Creek, MD 77 in Detour

N

Source: Frederick County GIS


Franklin County
Adams County
York County
Pennsylvania
Maryland
Washington County
Frederick County
Emmitsburg
Bridgeport
15
Taneytown
Thurmont
Union Bridge
Westminster
New Windsor
Woodsboro
Walkersville
Monocacy Blvd.
Frederick City
40
Interstate 70
New Market
70
Mount Airy
270
Carroll County
Potomac River
Virginia
River Gauges
Monocacy River Watershed
Monocacy River Guage Locations
0 1.5 3 6
Miles
Projection: NAD 1983 State Plane Maryland FIPS 1900 Feet
Source: United States Geologic Survey (USGS)
N

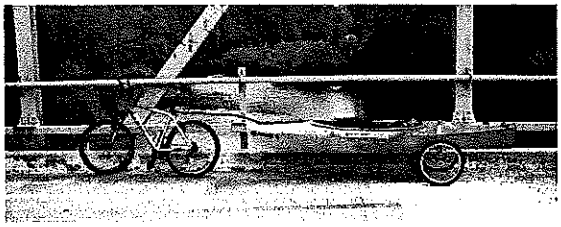
federal, state, and County River-front parks. In addition, Carroll has a 10 mile water trail on Double Pipe Creek and Big Pipe Creek with access points at Hapes Mill Road and Double Pipe Creek Park in Detour—a short paddle away from the Monocacy Scenic River. All access points can accommodate canoes and kayaks and some have ramps for launching small, motorized boats. However, the River is generally shallow and rocky, so large motorized boats are not recommended for use in the Monocacy.

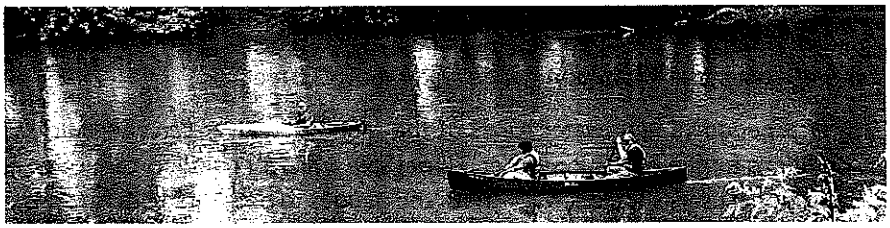
River Levels and Flows

Paddling the River is a fun and relaxing way to experience the River's wonders and wildlife up-close. While the River, under normal flow rates, is relatively calm and slow, preparation, care, and caution are paramount before beginning a floating adventure on the Monocacy River. The ideal time to paddle the Monocacy is in spring to mid-summer and from late fall to winter. The River has a gentle gradient of approximately three feet per mile, resulting in an average paddling speed of about two miles per hour. At average flows, the water velocity is approximately .83 miles per hour. At this rate, it takes three days for water to flow the entire length of the river. Check the following link for the 2014 Monocacy River Water Trail map for more details on paddling the Monocacy River:

http://news.maryland.gov/dnr/2014/05/08/new-water-trail-guide-helps-paddlers-explore-monocacy-scenic-river-in-frederick-county/ or http://www.recreater.com/292/Monocacy-Scenic-Water-Trail-Map

Below is some reference information and materials to research for an enjoyable and safe paddle on the Monocacy River.

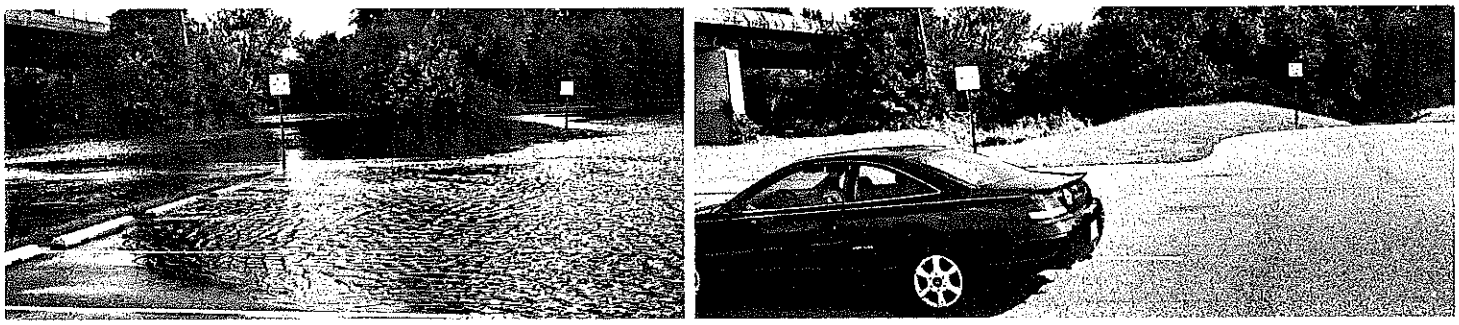




- Edward Gertler's Maryland and Delaware Canoe Trails. This privately published book directed towards paddlers contains information about the Monocacy River and several tributaries including the Big Pipe/Little Pipe/Double Pipe watershed. The book may be found in some book stores, libraries, and on-line shopping sites.
- "Monocacy Scenic River Water Trail" is a map published in 2014 jointly by the Maryland Department of Natural Resources and Frederick County Division of Parks and Recreation. It covers the lower 41.8 miles from the Rt. 77 bridge near Rocky Ridge to the Mouth of the Monocacy, the river's confluence with the Potomac River. Maps are available from government agencies, at the Monocacy National Battlefield, and from the Tourism Council of Frederick County. (http://news.maryland.gov/dnr/2014/05/08/new-water-trail-guide-helps-paddlers-explore-monocacy-scenic-river-in-frederick-county/ or http://www.recreater.com/292/Monocacy-Scenic-Water-Trail-Map)
- The United States Geological Survey (USGS) maintains a website with real time gauge readings for water levels of most rivers of consequence in the U.S., including the Monocacy and several tributaries. The four major gauge stations applicable to the Monocacy are: Bridgeport at the Rt. 140 bridge, the Monocacy Boulevard station in Frederick, the "Jug Bridge" station near the I-70 bridge in Frederick, and the Bruceville station on Big Pipe Creek near Detour. Computer access to these sites can be gained through a link to "River Levels" on the website hosted by the Frederick-based Monocacy Canoe Club: http://www.monocacycanoe.org/ or http://md.water.usgs.gov/surfacewater/streamflow

For paddlers (canoes and kayaks), minimum water levels are listed in Gertler's guidebook using the Jug Bridge gauge: 2.9 feet for the river above Rt. 77, 2.1 feet between Rt. 77 and Monocacy Blvd., and 1.7 feet for the lower river. The river is usually runnable below Rt. 77 in all but dry periods during summer months. The upper sections of the river can be paddled most frequently during the spring months when the Bridgeport gauge reads above 3.0 feet.

After a period of rain, water levels of the Monocacy River can rise quickly, creating dangerous conditions for the recreational user. Upper safe limits for paddlers cannot be established; however, recreational users should always check the gauges to note rapid fluctuations, including conditions upstream of the sections under consideration. It is advised to also compare the current water levels with historical mean levels for that date, as presented on the gauges.



Fifteen-foot River levels occurred on June 27, 2015 and resulted in several water rescues from the Monocacy, including this at Monocacy Boulevard. Note the picture on the right of the same location during normal River flows. The June 27, 2015 River level of 15 feet at Monocacy Boulevard is considered the 'Action Stage' of a flood event at Monocacy Boulevard per the USGS (see Appendix for detailed information on the River's gauges and their application for preparing for a safe and enjoyable paddling trip on the Monocacy River.

Recommendations

8-1) The River Board should undertake annual or bi-annual informal inspections of all public River access spots and report problems or issues to the appropriate governing body with operational and maintenance oversight (Frederick County, Frederick City, Maryland Department of Natural Resources, Maryland State Highway Administration, National Park Service)

8-2) All Monocacy River jurisdictions should assist the USGS or State of Maryland, if requested, in the financial operation and maintenance of flow gauges on the mainstem of the Monocacy River

8-3) Frederick County and the City of Frederick include an ecological resiliency component for climate change adaptation in the management of all public Riverfront parkland and open space.. This could include such things as reforestation, wetland enhancements, proper siting of structures, and invasive plant species control

8-4) To increase public awareness, appreciation and engagement with the Monocacy River, Frederick County Parks and Recreation should reinstate the public canoe trips offered on the Monocacy River

8-5) All Monocacy River jurisdictions promote the Monocacy River as a priority area for public land acquisition that is voluntary and/or from willing sellers or landowners for public open space, river access, passive parkland, habitat and resource protection, and seek sources of funding (federal, state, and local governments, foundations, and NGO's) for purchases of such land

8-6) Frederick County should allocate a portion of the Recordation Tax to fund acquisition from willing sellers or landowners of Monocacy River front property for public parkland open space, and for buffer creation and habitat improvement

8-7) The River Board will explore an effort to lobby the local U.S. Congressional delegation for funding from the 'Rivers of the Chesapeake Initiative', (part of the Federal Land and Water Conservation Fund, designed to protect large-scale landscapes for wildlife habitat and protection of water quality and scenic vistas). The 'Rivers' initiative targets lands for acquisition that are voluntary and/or from willing sellers or landowners that are adjacent to areas owned by governmental entities, or adjacent to lands already protected through conservation easements. Collaborate with appropriate local and state agencies and target lands along the River from Pinecliff Park south to the Potomac River for acquisition that is voluntary and/or from willing sellers or landowners of The Monocacy.

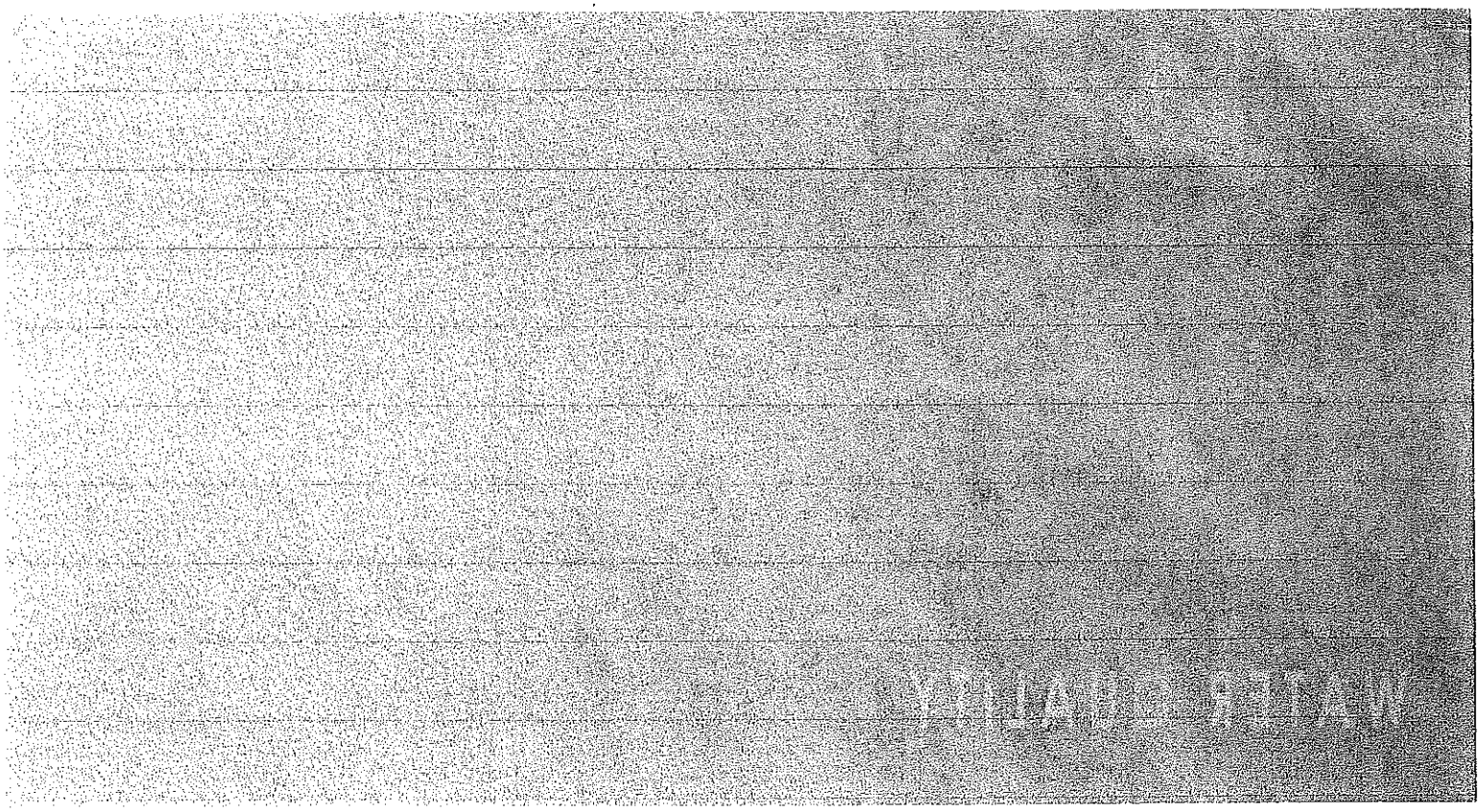
8-8) Continue the River Board commitment to increasing public awareness about the Monocacy River and its ecological resources, through public relations and educational programs

8-9) The River Board should lobby both the Frederick County and Carroll County Boards of Education and offer assistance to develop educational programs for students about the Monocacy River and its rich resources

8-10) The River Board should work with the Maryland Wild and Scenic Rivers Act to provide protection for the Monocacy River.

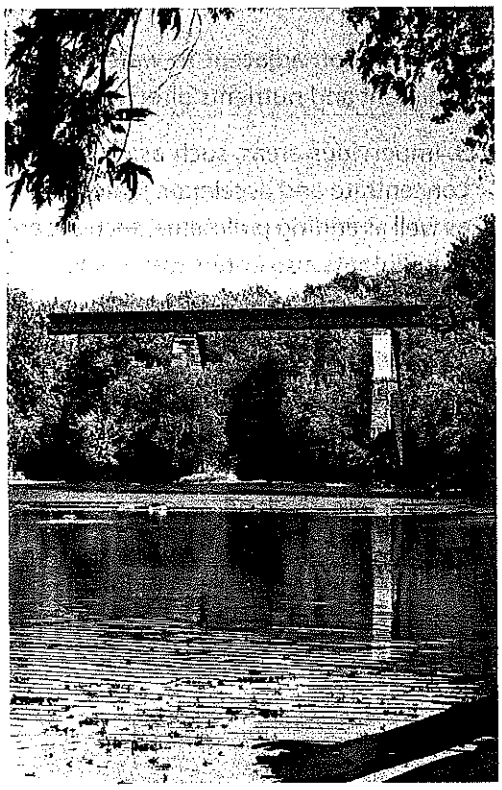
8-11) A stakeholder workgroup comprised of local law enforcement, River-front landowners, representatives from parks departments, and others interested in outdoor recreation and the Monocacy River, should be convened to update the Monocacy Scenic River Access Plan.

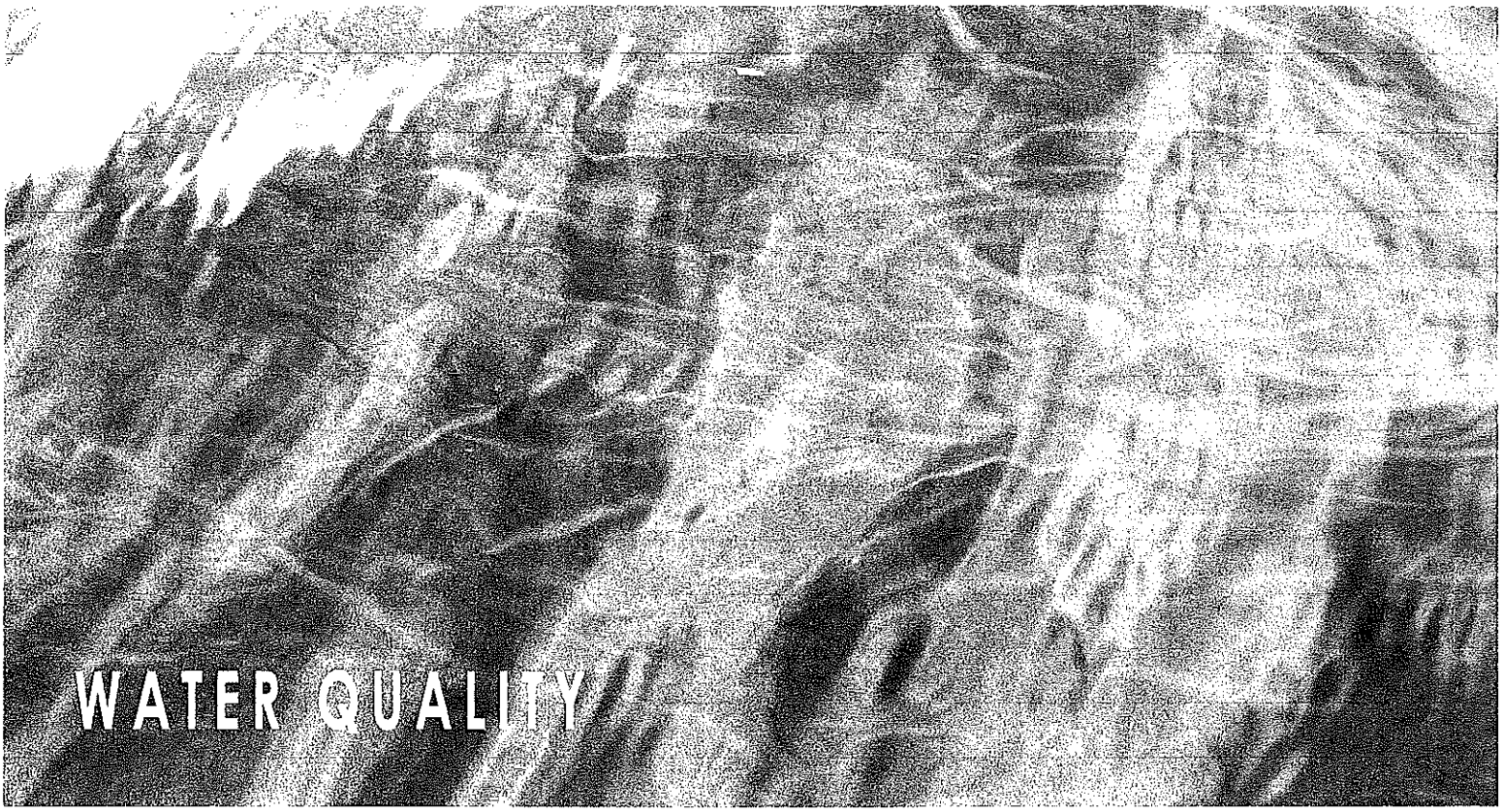
8-12) Develop signage for the public River access points that includes information regarding responsible use of the River and respect for private property



If a man fails to honor the rivers,
he shall not gain the life from them.

Anonymous





WATER QUALITY

Streams and rivers are located at the low point on the landscape and receive runoff from activities and uses that occur on the land. All land development and uses—past and present—impact water quality, aquatic life, as well as the surrounding ecological environment. Inadequate riparian buffers, unsound land use practices, insufficient stormwater management, and poor natural resource stewardship all contribute to stream bank erosion, sedimentation and degradation of water quality, affecting the quality of all life in a watershed, from the smallest macroinvertebrate to the largest mammals—including humans. A few examples of land uses that can degrade water quality include:

1. Livestock with unfettered access to streams and rivers. Livestock can trample banks and cause excess erosion and bacteriological and nutrient pollution in our waterways.

2. Cultivation adjacent to waterways. Cultivation, without sufficient vegetative buffers, can deliver excess sediment and nutrients directly into our streams and rivers.

3. Impervious areas, such as roof-tops, roads, parking lots, and compacted turf grass. Impervious surfaces concentrate and accelerate water that runs-off these areas after storm events and may exacerbate flooding as well as adding pollutants, such as sediment, oils, and chemicals to our waterways. Atmospheric deposition of pollutants also enters waterways.

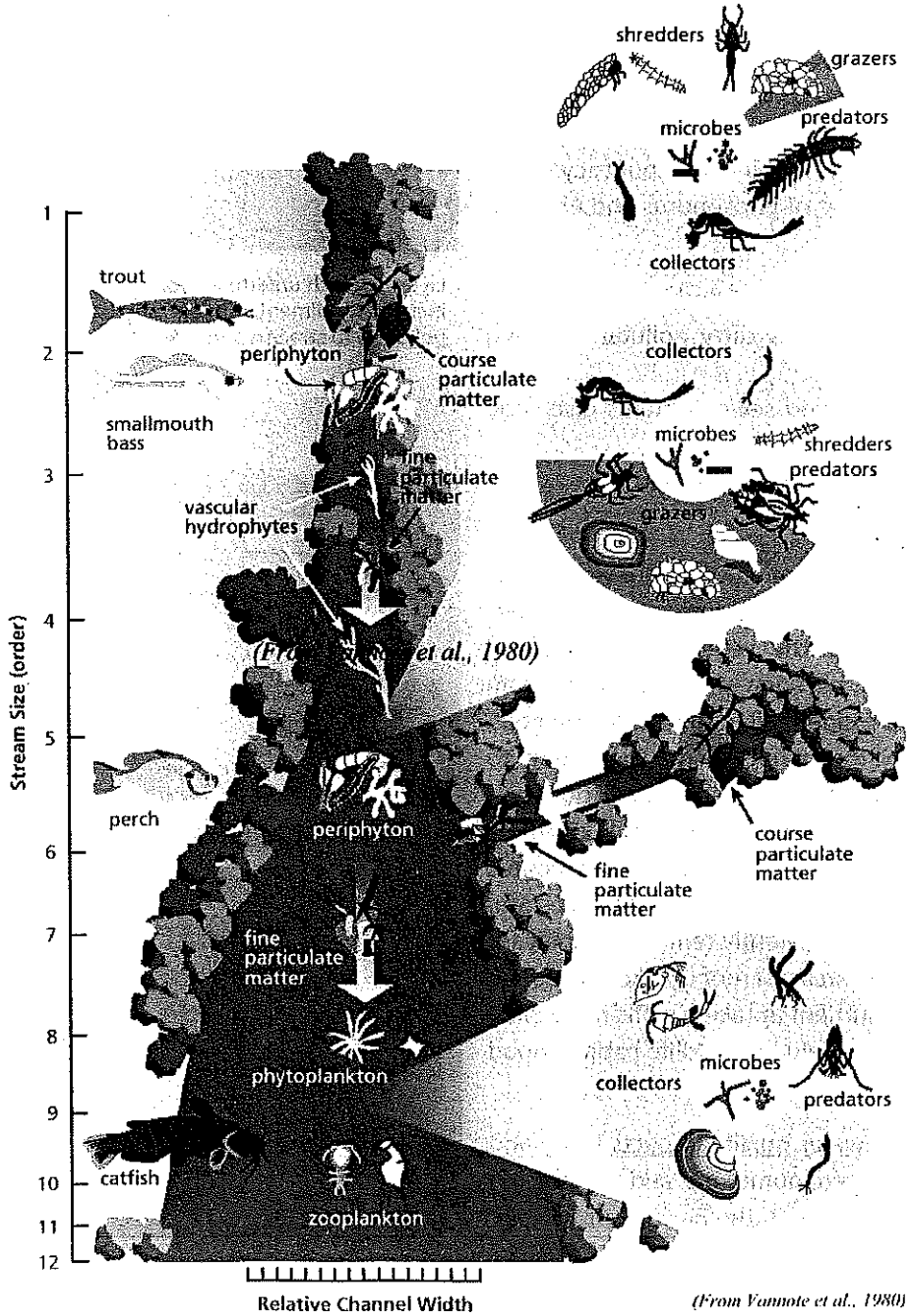
The Monocacy River's water comes from all the tributary streams present throughout its watershed that eventually flow into the mainstem of the River and from groundwater sources. Some of the Monocacy's tributaries are large, fifth-order (or higher) streams that have miles of smaller streams that flow, converge, and grow into larger streams that eventually empty into the Monocacy River. Some tributaries that flow directly into the Monocacy River are relatively small first or second order streams draining just a few hundred acres or less. The landscape throughout the Monocacy River Watershed varies greatly; some areas have high concentrations of forested land, agricultural land, or human development. The variety and extent of these land uses—and their management—in the Monocacy River Watershed directly impact water quality in the streams and eventually the Monocacy River.

River Continuum Concept

Another concept to aid further understanding the complex and dynamic nature and hierarchy of our aquatic systems—from small streams to the Monocacy River—is the 'River Continuum Concept' (Vanote et al., 1980). Streams grow and change in many ways from the beginning trickles in headwater streams to becoming large rivers. Picture the coalescing network of capallaries, veins, and arteries in our bodies; it's similar to the streams on our landscape.

Headwater streams are cooled by groundwater springs and generally have steeper gradients with riffles—rocks—in the stream and (in healthy systems) plenty of overhanging trees and vegetation. These streamside trees provide shade (to keep water cool for fish and stream insects) plus provide leaves, twigs, seeds, and grass stems that are consumed by the 'shredders'—stream insects (benthic macroinvertebrates) such as the larval forms of stoneflys and craneflys, plus crayfish. As streams converge and flow together, the stream gets wider, has fewer riffles, and receives more sunlight that promotes the growth of aquatic plants. The biological community of the stream also changes due to the change in the food inputs—there is less coarse material (leaves, twigs, seeds) in the stream and more fine particulate matter in the stream thanks to the shredders upstream. The feeding groups known as scrapers, grazers, filters and collectors (larval caddisflys, mayflys, and blackflys) are prevalent in the medium-sized streams.

Finally, in rivers—like the Monocacy—temperatures become higher as more sunlight reaches the water. The leaves, twigs, and seeds (terrestrial organic matter) are minor components of the river, compared to the volume of water. Dissolved organic material is prevalent in the water. Submerged grasses and benthic algae and cyanobacteria (blue green algae) colonize the shallow bottom areas. Drifting phytoplankton and zooplankton in the river contribute to the food base as does organic material from the adjacent floodplain during flooding events. Fish species in the Monocacy are omnivores and plankton feeders such as carp, catfish, and bass.



(From Vannote et al., 1980)

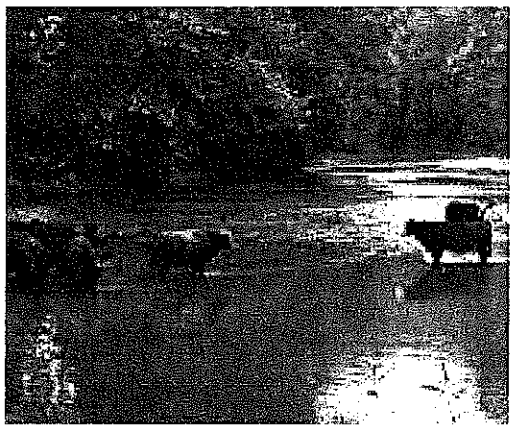
Three (3) main pollutants of concern within our waterways—including the Monocacy River—are total suspended solids (sediment), phosphorus, and nitrogen. Sediment pollution in waterways occurs when land is disturbed by clearing natural vegetation near water, grading to 'level' the land, cultivation, or grazing. The exposed soil runs off the land and can enter streams and rivers. Phosphorus and nitrogen are nutrients that are natural parts of aquatic ecosystems. They both support algae growth and aquatic plants, which provide food and habitat for fish and other aquatic organisms. However, excessive phosphorus and nitrogen, usually from a wide range of human activities, in the water causes eutrophication, which: 1) causes a rapid growth in algae; 2) significantly harms water quality, aquatic food resources, and habitats by blocking sunlight needed for submerged aquatic vegetation to photosynthesize; and 3) reduces oxygen levels in water caused by the die-off and decomposition of algae. Some algal or cyanobacteria blooms are harmful to humans because they produce elevated toxins that can make people sick if they come into contact with polluted water, consume tainted fish or shellfish, or drink contaminated water. As polluted runoff enters streams and creeks from various land uses within the Monocacy basin, the potential for eutrophication increases. Sources of phosphorus and nitrogen include:

- agriculture (e.g., animal manure, excess fertilizer, soil disturbance);
- stormwater (e.g., impervious areas such as roads carry pollutants during storms);
- wastewater (e.g., ineffective septic systems and sewer systems discharge pollutants);
- fossil fuels (e.g., electric power generation, transportation); and
- residential activities (e.g., fertilizers, pet waste)

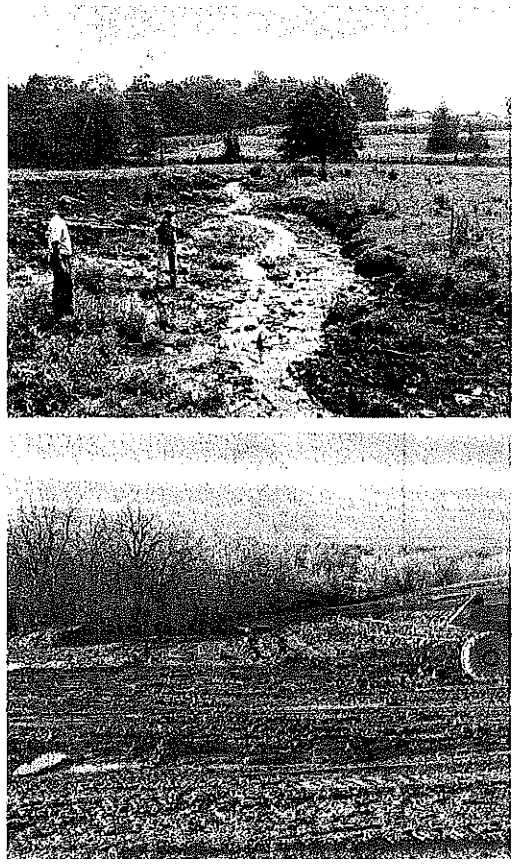
There are many solutions to preventing pollution from entering our waterways, one of which is a separation or buffer between all land development and activities (e.g., development, agriculture). A robust and healthy vegetative buffer along streams and rivers is key to reducing sediment, nitrogen and phosphorus from entering surface waters, as is agricultural (and residential) nutrient management, sediment and erosion control, and stormwater management. The extent to which riparian buffers attenuate nitrogen and improve stream water quality is though to be at least partly a function of buffer width (Vidon & Hill 2004), by some estimate, accounting for 81% of a buffer's nitrogen removal effectiveness (Phillips 1989a). Mayer et al., (2005) found that while some narrow buffers (1-15m) removed nitrogen, wider buffers (>50 m) more consistently removed significant portions of nitrogen probably by providing more areas for root uptake of nitrogen or more sites for denitrification. In addition to nutrient uptake, a sufficiently-wide forested buffer along streams and rivers provides valuable wildlife habitat, flood control and bank stabilization.

There is distinction between Monocacy River water quality impacts from land uses in the watershed, which are widely dispersed, numerous, and cumulative, and from direct water quality impacts from land uses in the River's surrounding environment. For example, run-off from land development or cultivated fields adjacent to the River have high potential to deliver sediment and nutrients

A sediment fence that has failed, allowing soil to enter the aquatic system



Livestock with unfettered access to waterways increases sediment, nutrient, and bacteriological pollution to streams and rivers



Mass grading for land development

Nitrogen Cycle

Most of the nitrogen in aquatic systems—streams, rivers, lakes, ponds—is present as gas (N_2), ammonia (NH_4), nitrate (NO_3), and nitrite (NO_2) and organic (biotic) forms of these. Nitrogen enters aquatic ecosystems in one of several forms including nitrate nitrogen (e.g. fertilizers), particulate nitrogen (e.g. litter fall from trees), ammonium (e.g. sewage and animal waste), and nitrous oxides from fossil fuel combustion (Schlesinger 1997). Nitrogen can 'transform' or cycle through various forms—gas, soluble (dissolved), and particulate. Nitrate is transformed by biological processes including uptake by plants and microbial denitrification, a process where bacteria in an anaerobic (absence of oxygen) environment change nitrate nitrogen to N_2 the gas phase of nitrogen. The concentration and rate of supply of the nitrate is intimately connected with land use practices in the watershed. Nitrate nitrogen moves easily through soil (unlike phosphorus) and is quick lost from the land, if not taken up by plants, and enters surface and ground waters. Wetland and riparian vegetation contain the environments that enable natural biologic and chemical transformation or treatment of nitrogen into much less harmful substances.

Emerging Contaminants

Sometimes chemicals that had not previously been detected (or were previously found in far lesser amounts) are discovered in the water supply. These chemicals are known as 'contaminants of emerging concern' or simply 'emerging contaminants.' Emerging contaminants are important because of the risk they pose to human health, aquatic life, and the environment is not yet fully understood. Pharmaceuticals, personal care products, and endocrine disrupting compounds (dioxins, polychlorinated biphenyls, pesticides) are examples of emerging contaminants. They commonly enter the environment from municipal, agricultural, and industrial wastewater sources and pathways. These newly recognized contaminants represent a shift in traditional thinking as many are produced industrially yet are dispersed to the environment from domestic, commercial, and industrial uses.

directly to the mainstem of the Monocacy River. Structures, impervious surfaces, and lack of natural vegetation along the River degrade the scenic qualities of the Monocacy River, short-circuit nutrient cycling and flood attenuation, and eliminate wildlife habitat.

Watershed-wide water quality impacts are varied and occur over a huge land area, impacting hundreds of miles of streams in the Monocacy's watershed and the Monocacy River directly. The Monocacy River is the end-point for all the streams in the watershed that drain the land and collect pollutants along the way. Maintaining buffers around stream headwaters will likely be most effective at maintaining overall watershed water quality, while restoring degraded riparian zones and stream channels may improve nitrogen removal capacity. (Mayer, et al.)

Run-off and discharge of pollutants from all land uses and sectors is regulated, to varying degrees, by federal, state, and local laws. Following is a summary of the federal, state, and local regulatory framework for surface water protection, as well as local watershed evaluations, protection efforts, and restoration programs.

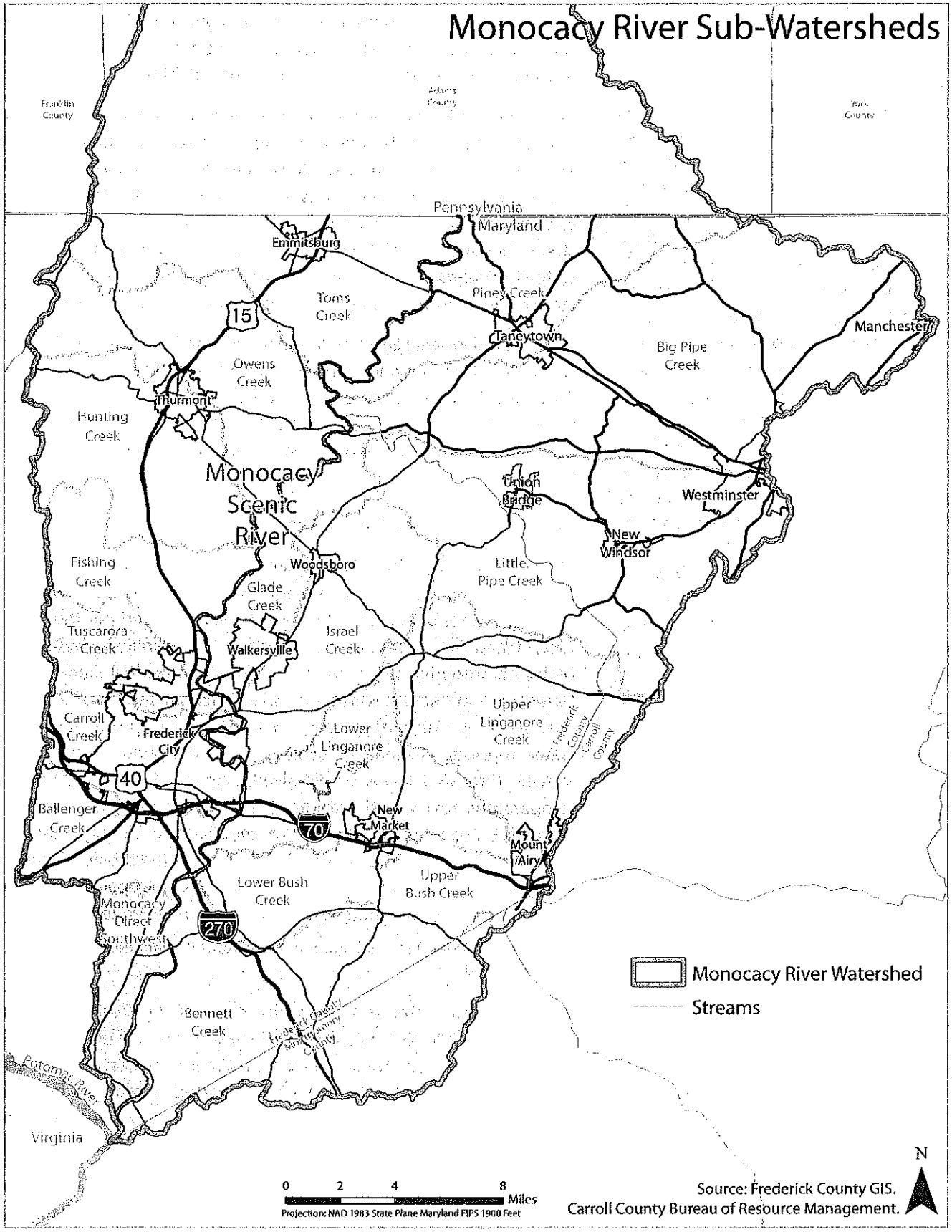
Federal And State Oversight

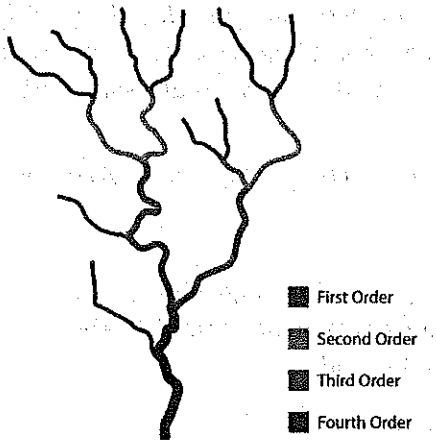
The Federal Clean Water Act requires states to develop water quality standards to protect and improve surface waters and wetlands. Maryland water quality standards have been adopted per the Federal Clean Water Act to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters." Individual standards are based on a particular waterbody use, function, goal, or 'designated use,' such as supporting trout populations or protecting public water supplies. Criteria to achieve these designated uses include specific threshold levels of dissolved oxygen, chlorophyll, bacteria, temperature, toxics, and turbidity (clarity) in waterways. The Clean Water Act also requires Maryland to monitor and identify water that does currently meet the standards for its designated use. A listing of these waterbodies can be found the Maryland Department of the Environment's (MDE) Integrated Report on Surface Water Quality:

http://www.mde.state.md.us/programs/Water/TMDL/Integrated303dReports/pages/2014IR.aspx

Maryland's designated water uses are identified in the Code of Maryland Regulations (COMAR) 26.08.02.08. The designated use of a waterbody refers to its anticipated use and any protections necessary to sustain aquatic life. A listing of Maryland's designated water uses and their specific application to waterbodies in the Monocacy River Watershed can be found in the Appendix under 'Maryland Designated Water Uses.'

The State of Maryland has determined, through water monitoring and computer modeling, that most waterways in the Monocacy River Watershed do not meet water quality standards. Thus, the MDE has


Monocacy River Sub-Watersheds
Franklin County
Adams County
York County
Pennsylvania
Maryland
Emmitsburg
Toms Creek
Piney Creek
Taneytown
Manchester
Big Pipe Creek
15
Owens Creek
Thurmont
Hunting Creek
Monocacy Scenic River
Union Bridge
Westminster
New Windsor
Fishing Creek
Woodsboro
Glade Creek
Little Pipe Creek
Tuscarora Creek
Walkersville
Israel Creek
Carroll Creek
Frederick City
Lower Linganore Creek
Upper Linganore Creek
Frederick County
Carroll County
40
Ballenger Creek
70
New Market
Mount Airy
Lower Bush Creek
Upper Bush Creek
Monocacy Direct Southwest
270
Monocacy River Watershed
Streams
Bennett Creek
Frederick County
Montgomery County
Potomac River
Virginia
0 2 4 8 Miles
Projection: NAD 1983 State Plane Maryland FIPS 1900 Feet
N
Source: Frederick County GIS.
Carroll County Bureau of Resource Management.



Stream Order

issued formal notices of water quality impairment, called Total Maximum Daily Loads (TMDL), for the watersheds and waterways listed in the table below.

A TMDL establishes the maximum amount of an impairing substance or stressor that a waterbody can receive and still meet water quality standards. TMDLs calculate pollution contributions from the entire watershed and then allocate reduction requirements to the various contributing sources of pollution. These allocations are divided among counties and towns and then further divided by sources, including agriculture, wastewater, and stormwater. (For more information: http://www.mde.state.md.us)

Impairment and Watershed or Waterway	Date Issued by MDE
Sediment on Double Pipe Creek	February 20, 2009
Sediment in Upper Monocacy River Watershed	December 3, 2009
Sediment in Lower Monocacy River Watershed	March 17, 2009
Sediment in Lake Linganore	May 13, 2003
Fecal Bacteria on Double Pipe Creek	December 3, 2009
Fecal Bacteria in Upper Monocacy River Watershed	December 3, 2009
Fecal Bacteria in Lower Monocacy River Watershed	December 3, 2009
Phosphorus on Double Pipe Creek	April 26, 2013
Phosphorus in Upper Monocacy River Watershed	May 7, 2013
Phosphorus in Lower Monocacy River Watershed	May 22, 2013
Phosphorus in Lake Linganore	May 13, 2003

The Monocacy River And The Chesapeake Bay

The Monocacy River Watershed is not unique in its impairments; there are over 300 TMDLs in Maryland. In fact, due to the numerous water quality issues in Maryland (and nearby states) and their ultimate impacts on the Chesapeake Bay, the US Environmental Protection Agency (EPA) issued a TMDL for the entire Chesapeake Bay Watershed in 2010. After decades of voluntary efforts to fully restore the health, productivity, and resiliency of the Chesapeake Bay, the US EPA established pollution load limits to restrict three major pollutants fouling the Bay's water: nitrogen and phosphorus (nutrients) and sediment (soil) from agriculture, land development, and wastewater treatment plants. These loading limits, which set clear goals for reducing excess pollution, are science-based estimates of the amount of each substance the Chesapeake Bay and its tributaries—like the Monocacy River-- can receive and still meet standards for clean, healthy water. The goals, or pollution reduction targets, require the seven jurisdictions in the Chesapeake Bay watershed (Maryland, Virginia, Pennsylvania, Delaware, West Virginia, New York and the District of Columbia) to reduce their nutrient and sediment loadings to the Bay until these protective limits are met, within a specific time frame (MD Department of the Environment).

The seven (7) Bay jurisdictions created individual Watershed Implementation

Safe Yield of a Public Water Supply

According to the American Society of Civil Engineers' Water and Wastewater Control Engineering, the safe yield of a public water supply is the maximum dependable draft (withdrawal) that can be made continuously on a source of water supply during a period of years during which the probable driest period or periods of greatest deficiency in water supply is likely to occur. [1]

1) Joint Committee of American Public Health Association, ASCE, American Water Works Association, and Water Pollution Control Federation, New York, NY: American Society of Civil Engineers, 3rd ed.

Plans (WIPs), or restoration blueprints, that detail specific actions from each activity or sector—agriculture, land development, and wastewater treatment—the States will take to meet their pollution reduction goals by 2025. The blueprints guide local and state Bay restoration efforts through the next decade and beyond.

The local WIP reports vary in length and detail, but generally include the following information:

The News

40 Per Cent Vote Seen For Primary

Gemini 11 Catches Up With Agena

Two County Rivers At Record Low Flow

D. C. Area Takes Most Of Potomac

Short Session Expected For Grand Jury Here

5 Flee To W. Germany In Bulldozer

LBJ's Curbs On Inflation Go To House

Oklahoma Brunette Is Miss America

South Vietnam Election Seen As Rebuff To Reds

Local Students' Dress SOP

3,300 Students

Area Colleges Begin Fall Terms

Front page from *The News*, September 12, 1966

- Overview of local WIP team process, description of team membership, and summary of Phase I and II WIP efforts
- Local area narrative strategies to achieve nutrient and sediment reductions
- Local area 2012-2013 milestones
- Description of local area tracking and reporting methods
- Optional description of local watershed planning frameworks
- Optional documentation of technical discrepancies, recommended future steps to address concerns
- Estimated reductions in loads from implemented use change.

For further detail or to download a one of the seven local WIP reports, see http://www.mde.state.md.us/programs/water/tmdl/tmdlimplementation/pages/wipphaseiicountydocuments.aspx

In addition to reaffirming commitments to restore the Bay's waters by achieving the nutrient and sediment reduction targets in the Chesapeake Bay TMDL, the Chesapeake Bay Watershed Agreement, signed by the Bay jurisdictions, addresses both climate change and toxic contamination as challenges whose solutions will ultimately increase the resiliency of the Bay and ensure that the Bay and its rivers are free from the effects of toxic substances on living resources and human

health.

Water Impacts

Watershed-wide water quality impacts are varied and occur over a huge land area, impacting hundreds of miles of streams in the Monocacy's watershed and the Monocacy River directly. The Monocacy River is the end-point for all the streams in the watershed that drain the land and collect pollutants along the way.

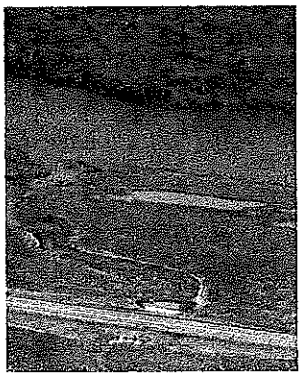
Protecting water quality and controlling water pollution from all land uses is, essentially, a human health and safety issue, and now a federal mandate in the 2010 EPA TMDL. We all have a stake—a responsibility—in maintaining the Monocacy River's health and protecting its water, as we depend on it as a source of drinking water and a resource for fishing, boating, and swimming. If sediment or other pollutant or toxin in the Monocacy River increases, additional strain will be placed on expensive water treatment processes and facilities; the River's aquatic biology will be harmed and the River negatively impacted and mandated nutrient and sediment load reduction will not be met. There is unassailable logic in long-term investments in the protection of a vital community and ecological asset like the Monocacy River.

Investment, incentives, regulation, and management actions for water quality and environmental protection in a watershed can decrease treatment costs of water for public consumption. The most famous example of this is the public water supply for New York City which is protected at the source in the Catskill Region of New York State.

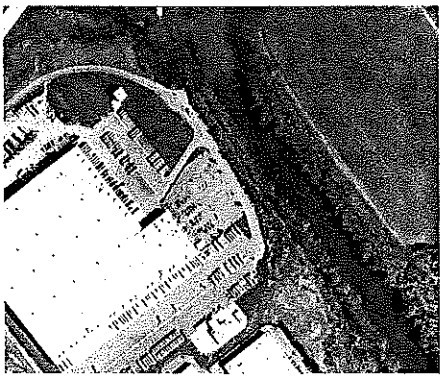
Water Use

The Monocacy River is used by the US Army Garrison at Ft. Detrick through Water Appropriation and Use Permit FR1943S001(03) issued by the Maryland Department of the Environment (MDE). Ft. Detrick is permitted to withdraw an average of 2.0 Million Gallons per Day (MGD) from the Monocacy River, with a maximum withdraw of 2.6 MGD.

The City of Frederick uses the Monocacy River as one of its four (4) sources of public drinking water, supplying approximately 27 percent of the City's total public drinking water. The City's Water



Monocacy River-front with no riparian vegetation and severe stream erosion



Industrial land uses along the Frederick County

Removal of riparian vegetation degrades the riverfront environment

Waterways can be impacted by stormwater infrastructure that has failed

Appropriation and Use permit (FR1961S001) allows for withdraws of 3.0 MGD, but contains a flow-by requirement whereby withdrawals must cease in order to maintain the health of the River's aquatic ecology: If the River's flow rate falls below 29 cubic feet per second (cfs) at the Jug Bridge Gauge, the City cannot withdraw water from the Monocacy. River flows below 29 cfs at Jug Bridge have been recorded for only 27 days during the 1929—2003 historical record, occurring during the droughts of 1966 and 2002.

The droughts of 1999 and 2002, coupled with the City's overallocation of the Monocacy River's water in the 1990's for land development approvals, led the MDE to declare the Monocacy River to have no safe yield as a public water source for the City of Frederick. A Consent Order (CO-02-01-WS, June 28, 2002) from MDE reduced the City's usage of the Monocacy River from 5.7 MGD (average annual) and 8.5 MGD (maximum day) to 3.0 MGD, with the new 'low-flow' or flow-by requirements previously mentioned.

In 2006, the City and County signed the Potomac River Water Supply Agreement which allocates and sells up to 8.0 MGD (maximum day, with ultimate procurement of 12 MGD) of water from the County's Potomac River supply for use by the City of Frederick. Prior to this 2006 agreement that supplied the City with additional water capacity, the Monocacy's use as a public water supply during droughts was severely constrained.

Water Supply

The Monocacy River is a fragile resource and crisis management to ensure public health, safety, and welfare (as well as River ecology) has been employed to ensure the sustainability of this resource.

One of the most severe droughts in Maryland occurred in 1966, when the Monocacy River reached a low of 17 cfs (or 11 MGD) below Frederick at the Jug Bridge Gauge on September 13, 1966. The 1966 drought prevented the City from using the Monocacy River for 56 days, when the River's flow rate fell below its then historical flow-by rate of 45 cfs (29 MGD). As a comparison, the 86-year average Monocacy River flow at Jug Bridge is 1030 cfs (665 MGD); the highest recorded flow was 81,600 cfs (52,739 MGD), which occurred during Hurricane Agnes on June 23, 1972.

Another drought in 1999 reduced the City's use of the Monocacy for 12 days (Frederick News-Post) and in 2002, the City was considering planned water outages as the River's flow was predicted to be below the flow-by rate for 60 to 70 days (Frederick News-Post)

Sixes Bridge Dam

Historical attention to water quality issues originated from health impacts on humans. By the 1890's epidemics of cholera and typhoid led public health officials to begin bacteriological testing. Legal issues with controlling pollution soon became interstate issues.

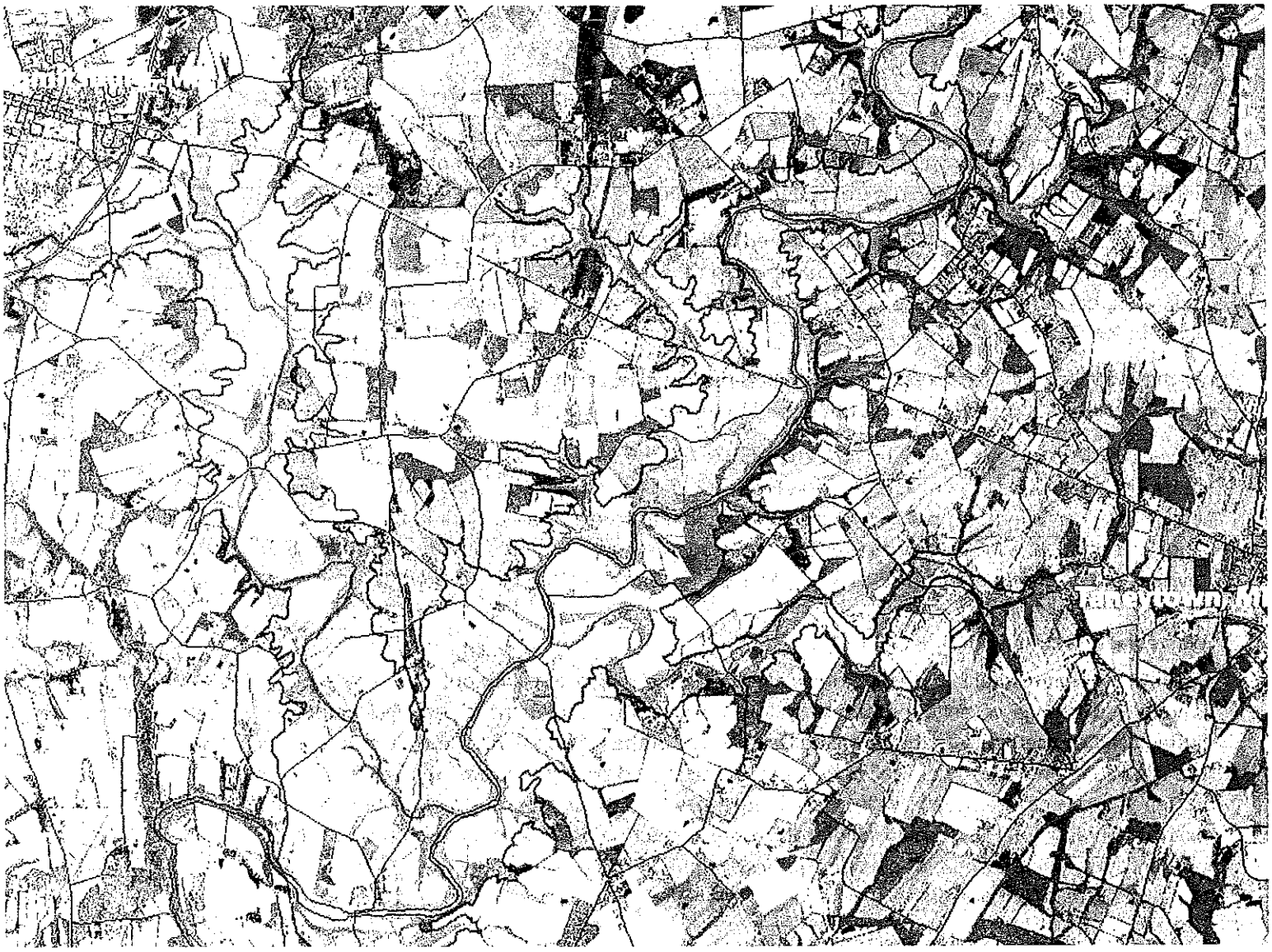
Filtration and chlorination of drinking water for urban areas ensued. Long

Innovative BMP Monitoring

Carroll County's innovative monitorin project will evaluate the pollutar removal efficiency of an enhanced san filter design developed by the Coun to improve the removal of nutrien from stormwater runoff. This projec located within the Monocacy Riv Watershed, will focus on the ma removal of phosphorus and will compa the pollutant removal capability of traditional sand filter versus an enhance sand filter using iron fillings as an adde media. In theory the iron additive with the aerobic layer of the sand filter shou bond with the oxygen present and wit the phosphorus in stormwater, formin an iron-orthophosphate nodule th precipitates out into the sand, increasin the removal of dissolved phosphor and therefore, total phosphorus fro stormwater runoff.

Sampling will include the data collectio from the influent and effluent side of th sand filter for the same storm events order to determine: mass removal dissolved phosphorus, total phosphoru total nitrogen, as well as determir the difference in total suspended solic between the standard sand filter desig and the enhanced sand filter design.

The results of this study will provic support to adopt the Carroll Count designed enhanced filter as a approved Best Management Practic by the Maryland Department of th Environment and the Chesapeake Bc Program.



Inundation area for the Sixes Bridge Dam.

before larger public awareness resulted in Chesapeake Bay regulations and concerns, the property rights movement fought to protect landowners whom pollutions effected. Early movements by groups like the Izaak Walton League in the 1920's for water quality led to initial conservation efforts.

Studies and reports continued to demonstrate issues with national waters until Congress began to notice and react. By 1940 Federal water quality regulations were adopted nationally, and in our region the Interstate Commission on the Potomac River Basin (ICPRB) was formed to address issues of supply and quality. By the early 1960's Federal studies by the Army Corps of Engineers demonstrated the need to allocate water resources and address adequate supply of potable water supplies for the region. A 1958 study by the U.S. Department of Health, Education, & Welfare led to a 1962 report by the Corps to develop future supply sources.

The Corps recommended a series of twenty-two regional dams to augment supply. One of these was to be a dam on the Monocacy River near Sixes Bridge Road where natural topography suggested that the damming of a large reservoir was an easily obtainable project that could supply Frederick, Gettysburg and Washington, DC.

Local officials and at first Federal officials supported the project, but local citizens activated against the project plan. For a decade the newspaper accounts argued for and against the project. Local leaders such as Bob Fischer developed a grassroots campaign by citizens called Save the Monocacy.

The Corps declared the project an emergency need for the region. Initial attempts to halt it by U.S. Representative Goodloe E. Bryon were rebuffed in Congress.

Initially positive of a Federal project that appeared to yield Federal dollars and natural and recreational benefits, U.S. Senator Charles Matthias championed the halting of the dam. It was halted in 1974. Julian Delphey, a member of the Maryland House of Delegates, was also a vocal opponent of the Sixes Bridge Dam.

By the 1980's, as the Chesapeake's issues gained prominence and regional agreements, groups in Frederick like Community Commons developed to support water quality.

Citizens looked for a platform to turn the efforts for the Monocacy's natural features into a commission to advise local governments in Frederick and Carroll counties on water issues. Local leaders like Jim Gilford campaigned the state to designate scenic rivers, including the Monocacy. Upon designation, a MSRB was created and a management plan adopted in 1992. This plan is a revision and extension of that first *Monocacy Scenic River Study and Management Plan.*

Wastewater Treatment

Wastewater treatment plants are considered a 'point-source' (where a specific outfall to a waterbody is visible) discharge of pollution and must receive a National Pollutant Discharge Elimination System (NPDES) permit from the Maryland Department of the Environment. These permits specify the allowable ranges for chemical, physical (quantities), and biological parameters of discharge, designed to protect the aquatic life in streams and rivers. Such parameters may include biochemical oxygen demand, total suspended solids, total residual chlorine, coliform organisms, pH, dissolved oxygen, and in most cases, nitrogen, phosphorus, temperature, flow, and other by-products of the wastewater treatment process.

The Monocacy River, as well as many of its tributary streams receives treated effluent from multiple wastewater treatment plants throughout the watershed. The three major wastewater treatment plants (WWTP) discharging directly into the Monocacy River are:

- Ballenger-McKinney (NPDES Permit MD0021822; State Discharge Permit No. 09-DP-0809)
- Frederick City (NPDES Permit MD0021610; State Discharge Permit No. 90-DP-0801)
- Ft. Detrick (State Discharge Permit No. 08-DP-2527)

Frederick County's main, regional WWTP—Ballenger McKinney—is permitted to treat 15 million gallons per day (MGD) of sewage utilizing Enhanced Nutrient Removal (ENR) and membrane bioreactors, a state-of-the-art treatment system that results in significant reductions in the discharge of pollutants, primarily nitrogen and phosphorus to permit levels of 4 mg/L total

PACKED HOUSE — More than 400 persons heard the testimony of speakers Friday night at Catoctin High School as they questioned the need for the proposed Army Corps of Engineers' Sixes Bridge Dam. A Corps official noted the opposition and said that feeling would be noted in the report to the Division Engineer. (News-Post Photo)

Photograph from the early 1970's, courtesy of the Frederick News Post

nitrogen and 0.3 mg/L total phosphorus.

The City of Frederick's WWTP is designed and permitted for treatment up to 8 MGD of sewage, with ENR technology.

The US Army Garrison-Ft. Detrick is a federal government facility where biomedical research and development, medical logistics, materials management, and global US Dept. of Defense telecommunications activities occur. The Army's WWTP at Ft. Detrick is designed and permitted to discharge up to 2 MGD of treated effluent into the Monocacy River. The Ft. Detrick WWTP also uses ENR technology.

Watershed Study, Monitoring, And Restoration

The following Section provides brief descriptions of work that has been or is being done in assessing the health of the Monocacy River Watershed.

Interstate Commission on the Potomac River Basin (ICPRB)

The ICPRB is an agency of the Potomac River Basin that performs studies and provides a sound science base that assists states with protecting water quality and related resources of the basin. The ICPRB promotes watershed-based comprehensive water resources planning.

Middle Potomac Watershed Assessment
From 2009 to 2012, ICPRB worked with the Nature Conservancy and the U.S. Army Corps of Engineers to develop the assessment, which examined the hydrology of the non-tidal Potomac (except for the North Branch) and how hydrologic changes from changes in use and climate could affect the ecology of the region's streams. The Monocacy watershed (both in MD and PA) was identified as one of the watersheds most at risk of degradation through changes in stream flow. The major culprits include increasing urban areas/impervious surfaces, increased water demand, and the karst geology in the region.

The Middle Potomac Watershed Assessment produced several products to increase understanding of the region's hydrology and to provide tools for planning sustainable water use, including:

- A basin-wide database of biological and water quality data;
- A more-refined hydrologic model;
- Future water use projections;
- Assessments of current hydrologic alteration based on water demand and climate change;
- Development of environmental flow recommendations for the mainstem Potomac; and
- Creation of hydrologic alteration-ecological response relationships to aid in development of environmental flow recommendations for tributary streams.

To view the complete report, see the following website: http://www.potomacriver.org/wp-content/uploads/2015/01/MPRWA_FINAL_April_2013.pdf

Frederick and Carroll Counties

Significant study and analysis of the condition of waterways and the landscape within the Monocacy River Watershed in both Carroll and Frederick County have been made since the 1990 Monocacy Plan was issued. A large portion of these have been mandated by the Federal Clean Water Act and subsequent Chesapeake Bay Clean Up initiatives.

Frederick County secured funding from the U.S. EPA to prepare Watershed Restoration Action Strategies (WRAS) for both the Lower and Upper Monocacy River Watersheds (completed in 2004 and 2005, respectively) to address the Monocacy River Watershed's impairments as listed in MDE's Integrated Report. The WRAS included a Stream Corridor Assessment, a field survey to evaluate and assess the overall instream and riparian habitat condition of selected stream corridors in the watershed; a GIS Watershed Characterization; and water quality monitoring at selected points in the watershed. Both the Upper and Lower Monocacy WRAS included measurable environmental goals, stakeholder involvement, and monitoring to address the water quality impairments within the watershed. The WRAS included initiatives such as restoring unbuffered waterways, protecting critical forested headwater areas and wetlands, implementing best management practices in urban and agricultural areas for nutrient reduction benefits, as well as developing pilot projects and other programs to address the negative human-induced impacts to water quality and habitat. Unfortunately, many initiatives remain unaddressed or incomplete.

The WRAS reports can be found here: http://www.watershed-alliance.com/

Stream Monitoring

Frederick County has a stream survey program to assess the status of County streams in terms of water quality, biological condition, and habitat. The survey employs a statistical design, using a random sampling approach to draw inferences about stream condition in each of the County's 20 watersheds and the entire County. The County Stream Survey was designed to answer key questions about the condition of the County's watersheds and streams and, in particular, the stressors affecting those streams. Since 2008, data have been collected on water quality, instream and riparian habitat, and biological communities at each of the stream sites. This information was then used to make an assessment of stream conditions Countywide. Please see the following website: http://www.frederickcountymd.gov/518/Watershed-Management

Carroll County's current monitoring strategy is focused primarily around stormwater retrofit locations where reductions in loadings can be documented from the before-and-after study approach. This comprehensive monitoring program is intended to validate the overall effectiveness of BMPs and document the efficiency of any innovations made to BMPs. Three of the County's monitoring locations are located within the Monocacy River Watershed. Bi-weekly monitoring by the County's Bureau of Resource Management involves the collection of chemical grab samples with corresponding discharge measurements in order to calculate nutrient and sediment loadings to waterways. Additional monitoring includes spring macroinvertebrate collection.

Carroll County has conducted stream corridor assessments within the Monocacy River Watershed to identify and rank impairments within the watershed to assist in prioritizing locations for restoration implementation. The assessments are based on Maryland Department of Natural Resources protocols and collect data on eroded stream banks, channel alterations, exposed utility pipes, drainage pipe outfalls, fish barriers (debris jams), inadequate streamside buffers, trash dumps, and grading activities that are either in or near the stream. Carroll County's monitoring and assessment information can be found at: http://www.ccgovernment.carr.org/ccg/resmgmt/

Stormwater Management

Various other watershed water quality improvements---stream restoration, stormwater management 0system upgrades, environmental education initiatives, and watershed evaluations/assessments—are included in both Frederick County and Carroll County's National Pollutant Discharge Elimination

System (NPDES) permit—aka 'stormwater permit.' The Clean Water Act authorizes the EPA, and states that are delegated the authority by the EPA, to regulate point sources that discharge pollutants into waters of the United States through the NPDES permit program.

"Point sources" are generated from a variety of municipal and industrial operations, including treated wastewater, process water, cooling water, and stormwater runoff from drainage systems. The NPDES storm water program, in place since 1990, regulates discharges from municipal separate storm sewer systems (MS4s), construction activities, industrial activities, and those designated by EPA due to water quality impacts. MS4 jurisdictions, such as Frederick and Carroll Counties are required to track, monitor, and report on activities related to stormwater discharge. In general, the permit requires the management and administration of the following categories:

- Source identification for pollutants in stormwater runoff countywide.
- Maintain a stormwater management program for development activities.
- Maintain an erosion and sediment control program for construction activities.
- Maintain an illicit discharge detection and elimination program that includes inspection and enforcement.
- Address problems associated with litter and floatables in waterways that adversely affect water quality.
- Maintain a property management and maintenance program for county-owned operations.
- Implement a public education and outreach program.
- Conduct stormwater restoration.

For further details on the MS4 NPDES permits in Frederick and Carroll Counties, see the following websites:

Frederick County: http://www.frederickcountymd.gov/518/watershed-management

Carroll County: http://ccgovernment.carr.org/ccg/resmgmt/

Maryland Department of Natural Resources

The Monitoring and Non-tidal Assessment Service of the Maryland Department of Natural Resources monitors the Monocacy River monthly at four locations. "Core-Trend" data is gathered from the following locations:

The Declaration from Maryland's Wild and Scenic Rivers Act (§8-401, Annotated Code of Maryland)

States, "Many of the rivers of Maryland or portions of them and their related adjacent land areas possess outstanding scenic, geologic, ecologic, historic, recreation, fish, wildlife, cultural, agricultural and other similar values. The policy of the State is to preserve and protect the natural values of these rivers, enhance their water quality, and fulfill vital conservation purposes by wise use of resources within their surrounding environment."

- Bridgeport (Site No. 0528)
- Biggs Ford Road (Site No. 0269)
- MD 144 (Site No. 0155)
- MD 28, Dickerson Road (Site No. 0020)

In addition to benthic macroinvertebrate collection, the following chemical parameters are analyzed monthly by the DNR from the 4 Core-Trend Stations:

Water Chemistry Parameters	**Measurement Units**
Total Organic Carbon	milligrams per liter (mg/L)
Total Suspended Solids	mg/L
Total Kjeldahl nitrogen	mg/L
Total phosphorus	mg/L
Turbidity	Nephelometric Turbidity Units (NTUs)
Total alkalinity	mg/L
Sulfate	mg/L
Ammonium	mg/L
Nitrate + Nitrite	mg/L
Nitrite	mg/L
Nitrate	mg/L
Phosphate	mg/L
Water Temperature	Celsius
Conductivity	micromhos (umhos/cm)
Total Dissolved Solids	parts per million (ppm)
Dissolved Oxygen	mg/L
pH	

For more information about Maryland DNR's core trend program, visit http://dnr2.maryland.gov/streams/pages/ctsites.aspx

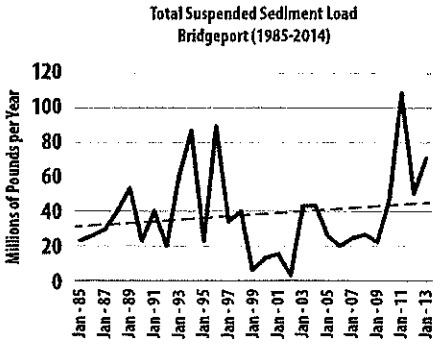
Water Quality — Concentrations

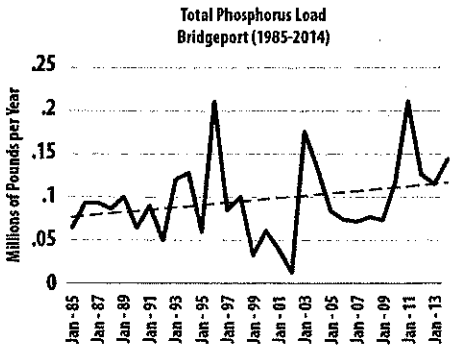
Below are 2 graphs comparing Total Suspended Solids (TSS) values from the Bridgeport monitoring site with the MD Rt. 28 site, which is over 50 miles down-river from Bridgeport and after the Monocacy River receives flow from its tributaries in Frederick and Carroll Counties. These readings reflect concentrations of sediment on one particular day each month, in each year from 1986—2012 at 2 sites on the Monocacy River. Several factors including river ecology, land use, and fluvial dynamics may explain the variability in the readings between these 2 sites.

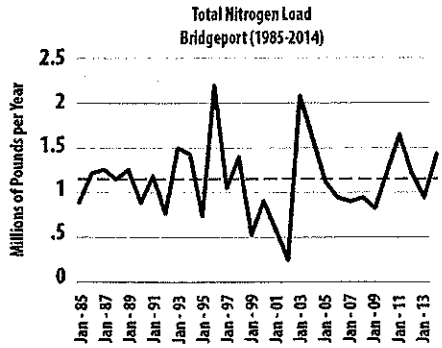
Concentration simply measures the amount of a substance or material in a specific volume of water—in this Monocacy River example, milligrams per liter (mg/L). Concentration is often a useful parameter to assess water quality because it has biological significance to organisms of concern (15). For example, concentration data is used to indicate levels of pollutants and other substances that can be toxic or harmful to fish and other aquatic organisms.

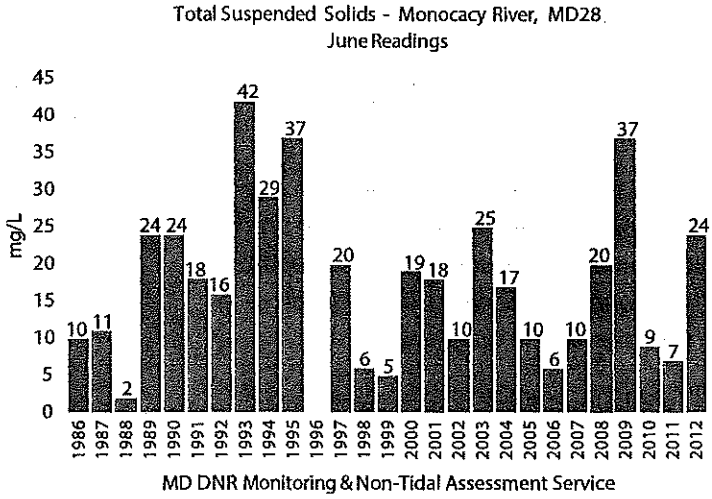
Water Quality — Loadings

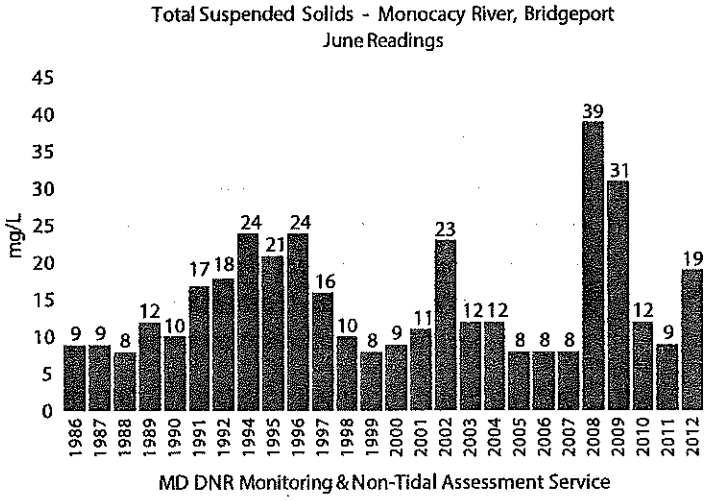
Pollutant loading is also a useful measure of water quality but, unlike concentration data, measures the amount of a substance or pollutant carried in a stream past a particular point for a given time











period, (e.g, kilograms per day, kg/day or pounds per year, lbs/yr). Stream or river flow or discharge data (e.g., cubic feet per second, ft3/sec) is key to calculating loading rates. The allocation of pollutant loading by source (e.g., agriculture, stormwater) is the foundation of the Federal TMDL process used nationwide to regulate water quality issues arising from nonpoint sources of pollution, as described elsewhere in this chapter.

Chesapeake Bay Nontidal Network

The Chesapeake Bay Nontidal Water Quality Monitoring Network is a partnership implemented among the States in the watershed, the U.S. EPA, the USGS, and the Susquehanna River Basin Commission. A network of monitoring stations has been established and is sampled using standardized protocols and quality-assurance procedures designed to measure pollutant loads and changes in pollutant loads over time.

The monitoring sites within the network track changes in nitrogen, phosphorus, and suspended solids in the Chesapeake Bay Watershed to determine loads and trends through discharge measurements, water quality sampling, and statistical analysis. One of the nontidal monitoring network sites is located on the Monocacy River at Bridgeport.

The Bridgeport site has been part of the nontidal monitoring network since 1985, and the water

quality information collected at this location has and will continue to play a crucial role in both the development and progress of local and Chesapeake Bay TMDLs. The following graphs show long term trends from the Chesapeake Bay Nontidal Network for total nitrogen, total phosphorus and suspended sediment at the Bridgeport monitoring location.

Recommendations

9-1) Frederick County, Carroll County, and all NPDES Phase I (populations greater than 100,000) and Phase II (populations less than 100,000) municipalities should continue to implement their programs to address required nutrient and sediment reductions to meet Chesapeake Bay and local TMDL's

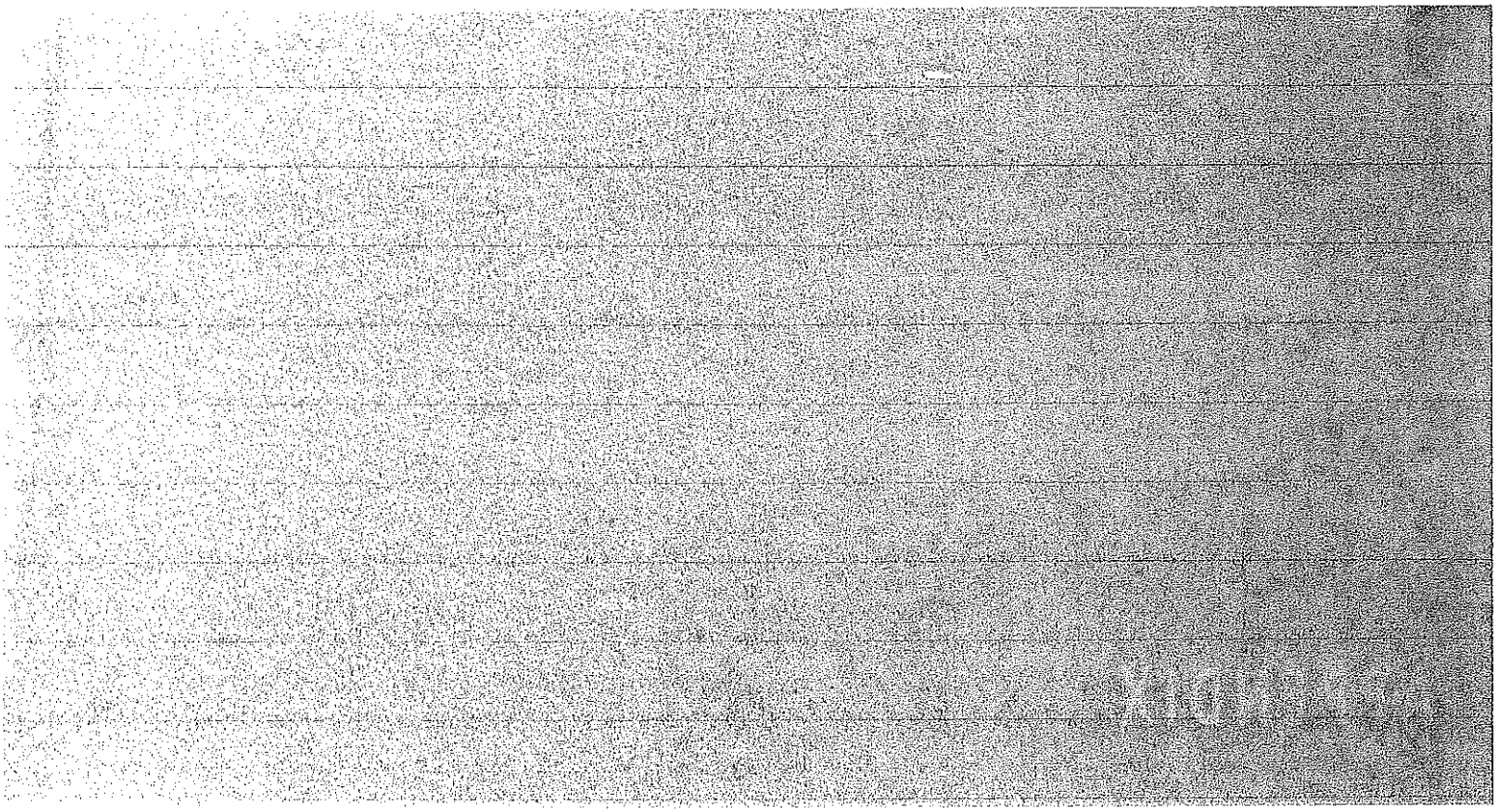
9-2) The River Board needs to engage more frequently with NPDES stormwater staff in Frederick County, Carroll County, Adams County, PA, and the Phase II municipalities in the Watershed to stay current about Monocacy River Watershed water quality issues

9-3) The River Board supports lobbying for an increase to Maryland's Used Tire Clean Up and Recycling Fund to generate additional resources for the clean-up, removal, processing, and reuse of tires dumped in our environment. Frederick County and Carroll County should subsidize and support expansion of the Maryland Farm Bureau's and Maryland Environmental Service's 'Farm tire drop-off day' (see River Board's involvement with tire removal from the River in Chapter 2)

9-4) The River Board encourages Frederick County and Carroll County to promote and fund additional hazardous and toxic material 'drop-off' days at the Reich's Ford Road Landfill and the Northern and Hood Mill Landfills to encourage proper disposal of hazardous materials and reduce illegal dumping which pollute ground and surface waters, including the Monocacy River

Sugarloaf Mountain

1. Glossary of Terms
2. References and Citations
3. Amphibians and Reptiles in the Monocacy Watershed
4. Fish Species Collected in the Monocacy River, 2006-2013
5. USGS Flow Data
6. ICPRB River Studies
7. Frederick County Historic Sites
8. Maryland's Wild and Scenic Rivers Act
9. Maryland's Designated Water Uses
10. Agroforestry Resources
11. Monocacy River Resource Map Sections



1 - GLOSSARY OF TERMS

Algae: is a group of microscopic plants found in sunlit waters. They are eaten by fish and small aquatic animals and, like all green plants, that produce oxygen during the day and consume oxygen at night.

Algae Bloom: is a proliferation of living algae on water surfaces simulated by nutrient enrichment. They are undesirable because of their appearance, the tastes and orders they impart to the waters, and the dramatic effects they often have on other aquatic life. The die-off and decay of algae blooms consumes dissolved oxygen, can lead to dead zones in water bodies that are unable to support life.

Best Management Practices (BMP): are the most environmentally, socially and economically appropriate treatment measures to control a water quality problem/issue.

Bioassay: is a laboratory test used to determine the response of organisms to specified conditions relating to the natural environment (e.g. water quality).

Bioreactor: is a Best Management Practice (BMP) where surface runoff is directed to a trench with a carbon source such as wood chips that allows bacteria to bread down nitrates through denitrification.

Buffer Zone: is an area situated between areas which are in possible conflict. The objective of a buffer zone is to reduce the possibility of adverse impacts from land use on water quality.

Conservation Resource Enhancement Program (CREP): is an offshoot of the Conservation Reserve Program (CRP) and targets high-priority conservation issues. In exchange for removing environmentally sensitive land from production and introducing conservation practices, farmers, ranchers, and agricultural and land owners are paid an annual rental rate.

Cyanobacteria Blooms: are blue-green algae of a number of species of microscopic bacteria that are photosynthetic and occur in surface waters. They have the potential to cause a variety of adverse health effects.

Denitrification: is the process by which microbes convert nitrate to molecular nitrogen. It most typically occurs around the root systems of riparian buffers.

Ecosystem: is a community of living organisms in conjunction with the nonliving components of their environment (things like air, water, and mineral soil), interacting as a system.

Effluent: is flow coming from a body of water or manmade system. The term is often used in the context of flow coming from wastewater treatment facilities.

Ecologically Sensitive Areas (ESAs): are areas that have been designed as potential habitats for rare, threatened, or endangered species.

Erosion: is the removal of land surface materials by wind or water. Erosion occurs naturally from weather or runoff but is often intensified by man's land clearing practices.

Federal Emergency Management Agency (FEMA) 100-Year Floodplain: is the combined area of the 100-Year frequency flood (including the floodway and floodway fringe), and appropriate floodplain.

Flood Information Tool (FIT): is the Federal Emergency Management Agency (FEMA) standardized nationally-applicable matrix of hazards loss estimation methodology.

Flood Insurance Rate Map (FIRM): is the official map of a community on which the Federal Emergency Management Agency (FEMA) has delineated both special hazard areas and the risk premium zones applicable to the community.

Floodplain: is that area of land adjoining a continuous watercourse which has been covered temporally by water during as given flood event.

Forrest Resource Ordinance (FRO): is a program that protects and enhances local forest resources to meet the State Forest Conservation Act of 1991. This program replaces forest that is removed as part of the development process and conserves remaining forest. It requires developers to plant forest in accordance with established thresholds and accepts Forest Banking Program (FBP) easements as credits that can be sold. Fee-In-Lieu (FIL) Program money collected through mitigation is used to help finance tree planting.

Ground Water: is water in the porous rocks and soils of the earth's crust; a large proportion of the total supply of fresh water.

Impervious Areas: are surfaces, such as pavement or rooftops, which prevent the infiltration of water into the soil.

Hazardous Substance: is a chemical substance or compound which may for example, be toxic to humans and animals.

Hydrology: is the scientific study of the movement of water through the cycle of rainfall, runoff, and evaporation.

Low Flow: is typically the average flow for a week during a given ten-year period having the least water volume. It is used for calculating discharge permit limits.

Natural Pollutants Discharge Elimination System (NPDES): is the permit program that addresses water pollution by regulating point sources that discharge pollutants to waters of the United States.

Nutrient: is a component in food that organisms use to survive and grown. Plant nutrients include nitrogen and phosphorus that can negatively impact water quality by stimulating algae growth.

Pesticides: are agents to control pests. This includes insecticides for use against harmful insects; herbicides for weed control, fungicides for control of plant disease, etc.

Pollutant: is any gas, liquid, or solid or form of energy whose nature, location, or quantity produces undesirable environmental effects. Some general categories of pollutants are oxygen demanding wastes, pathogens, nutrients, sediment, heat, radioactivity and many chemicals.

No-till Planting/Farming: is a way of growing crops or pasture from year to year without disturbing the soil through mechanical overturning. No-till farming has been shown to reduce runoff and erosion.

Riparian Area: An area adjacent to or near streams, rivers, lakes, and ponds that is a transitional area between the aquatic environment and the terrestrial, upland environment. Riparian areas are characterized by unique soil types, vegetation communities, and ecological processes that are influenced by surface and subsurface water regimes.

Recommendation(s): is a suggested approach for consideration in guiding government action and land use decisions for the protection of waterway assets (river and watershed). Recommendations are not mandates but are offered for consideration.

Riparian Vegetation: is vegetative growth within an identified riparian area.

Saturated Buffers: is a Best Management Practice (BMP) where runoff from fields is diverted to a grass buffer where nutrients can be taken up by vegetation.

Sediment: is eroded soil particles which are transported by wind, water, and or man's actions that settle in time to the bottom of a stream or river.

Sludge: is solid residuals of any industrial or sewage treatment process.

Total Maximum Daily Loads (TMDLs): is a regulatory term in the U.S. Clean Water Act, which describes the values of the maximum amount of pollutant that a body of water can receive while still meeting water quality standards.

Topography: is the configuration of a surface, including its relief or relative elevations, and the position of its natural and manmade features.

Watershed: is a basin-like landform defined by highpoints and ridgelines that descend into lower elevations and stream valleys. A Watershed carries water "shed" from the land after rain falls and snow melts.

Watershed Implementation Plans (WIPs): are mandated plans for each watershed jurisdiction that define ways to meet Total Maximum Daily Load requirements.

Watershed Restoration Action Strategies (WRAS): are developed in cooperation with federal, state, and local agencies, water-based organizations and the public for those watersheds most in need of restoration and do not meet clean water natural resource and public health goals.

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AMPHIBIANS OCCURING WITHIN MONOCACY WATERSHED

Jefferson salamander (*Ambystoma jeffersonianum*)
Rare in forested areas, usually at higher elevations. Moves into temporary ponds to breed in early spring.

Spotted salamander (*Ambystoma maculatum*)
Common in forested areas along floodplain. Moves into temporary ponds to breed in early spring.

Marbled salamander (*Ambystoma opacum*)
Common in forested areas along floodplain. Moves to sites of temporary ponds to breed in fall.

Northern dusky salamander (*Desmognathus fuscus*)
Common in springs and small streams throughout watershed.

Two-lined salamander (*Eurycea bislineata*)
Common in springs and small streams throughout watershed.

Long-tailed salamander (*Eurycea longicauda*)
Uncommon in springs and small streams, and along banks of river.

Spring salamander (*Gyrinophilus porphyriticus*)
Uncommon in springs and small streams, mostly in western half of watershed.

Red-spotted newt (*Notophthalmus viridescens*)
Common in farm ponds, pools along floodplain, and backwater areas of river.

Red-backed salamander (*Plethodon cinereus*)
Common in forested and undeveloped areas throughout watershed. Terrestrial.

Slimy salamander (*Plethodon glutinosus*)
Uncommon in forested areas throughout watershed. Terrestrial.

Red salamander (*Pseudotriton ruber*)
Uncommon in springs and small streams throughout watershed.

Cricket frog (*Acris crepitans*)
Uncommon in ponds, swamps and backwaters along river.

American toad (*Bufo americanus*)
Common throughout watershed.

Fowler's toad (*Bufo w. fowleri*)
Uncommon throughout watershed.

Gray treefrog (*Hyla versicolor*)
Uncommon in forested areas of watershed. Breeds in ponds and swamps during summer.

Spring peeper (*Pseudacris crucifer*)
Common throughout watershed. Breeds in ponds and swamps during spring and summer.

Upland chorus frog (*Pseudacris feriarum*)
Uncommon in forested areas of watershed. Breeds in swamps during spring.

Bullfrog (*Rana catesbeiana*)
Common in ponds, swamps, and along river throughout watershed.

Green frog (*Rana clamitans*)
Common in ponds, swamps, and along river throughout watershed.

Northern leopard frog (*Rana pipiens*)
Uncommon in ponds, along streams and floodplains.

Pickerel frog (*Rana palustris*)
Uncommon in ponds and along streams.

Wood frog (*Rana sylvatica*)
Common in forested areas of watershed. Comes to ponds and swamps to breed in spring.

Spadefoot toad (*Scaphiopus holbrookii*)
Rare and possibly extirpated within watershed. Burrowing species that breeds in temporary pools in summer.

Marbled salamander -

Reptiles Occurring Within Monocacy Watershed

Copperhead (*Agkistrodon contortrix*)
Uncommon throughout watershed. Congregates in rocky areas during spring and fall.

Worm snake (*Carphophis amoenus*)
Uncommon, under rocks and logs throughout watershed.

Black racer (*Coluber constrictor*)
Common throughout watershed.

Timber rattlesnake (*Crotalus horridus*)
Uncommon and local, primarily in rocky areas at higher elevations.

Ringneck snake (*Diadophis punctatus*)
Common throughout watershed.

Black rat snake (*Elaphe obsoleta*)
Common throughout watershed.

Hognose snake (*Heterodon platirhinos*)
Uncommon throughout watershed.

Milk snake (*Lampropeltis triangulum*)
Common throughout watershed.

Water snake (*Nerodia sipedon*)
Common around water bodies throughout watershed.

Smooth green snake (*Opheodrys vernals*)
Uncommon in western half of watershed.

Queen snake (*Regina septemvittata*)
Uncommon along streams throughout watershed.

Brown snake (*Storeria dekayi*)
Uncommon throughout watershed.

Red-bellied snake (*Storeria occipitomaculata*)
Uncommon throughout watershed.

Ribbon snake (*Thamnophis sauritus*)
Uncommon along streams and floodplains throughout watershed.

Garter snake (*Thamnophis sirtalis*)
Common throughout watershed.

Smooth earth snake (*Virginia valeriae*)
Uncommon, lower elevations throughout watershed.

Snapping turtle (*Chelydra serpentina*)
Common in ponds, swamps, and in river throughout watershed.

Spotted turtle (*Clemmys guttata*)
Uncommon along streams and in swamps throughout watershed.

Wood turtle (*Clemmys insculpta*)
Common in forested areas throughout watershed.

Painted turtle (*Chrysemys picta*)
Common in ponds, swamps, and in river throughout watershed.

Mud turtle (*Kinosternon subrubrum*)
Uncommon in lower portion of river.

Red-bellied turtle (*Pseudemys rubriventris*)
Uncommon in the river and its larger tributaries.

Stinkpot turtle (*Sternotherus odoratus*)
Common in river and occasionally in ponds and swamps throughout watershed.

Box turtle (*Terrapene carolina*)
Common throughout watershed.

Red-eared turtle (*Trachemys scripta*)
Uncommon in ponds, swamps, and lower portion of river.

Five-lined skink (*Eumeces fasciatus*)
Rare and local.

Fence lizard (*Sceloporus undulatus*)
Uncommon in undeveloped areas throughout watershed.

4 - FISH SPECIES COLLECTED IN THE MONOCACY RIVER 2006-2013

Upper = PA line downstream to Monocacy Blvd. Lower = downstream of Monocacy Blvd to junction with Potomac River. Fish species general occurrence (A = abundant: > 100 individuals, C = common: 5-100 individuals; S = scarce: < 5 individuals). MD DNR

Common Name	Scientific Name	Upper	Lower
American eel	Anguilla rostrata	C	C
Gizzard Shad	Dorosoma cepedianum		S
Central Stoneroller	Campostoma anomalum	A	C
Spotfin Shiner	Cyprinella spiloptera	A	A
Common Carp	Cyprinus carpio	C	C
Cutlip Minnow	Exoglossum maxillingua	S	
Silvery Minnow	Hybognathus nuchalis		S
Common Shiner	Luxilus cornutus	A	A
River Chub	Nocomis micropogon	C	C
Comely Shiner	Notropis amoenus	C	C
Silverjaw Minnow	Notropis buccatus	C	S
Spottail Shiner	Notropis hudsonius	A	A
Swallowtail Shiner	Notropis procne	A	A
Rosyface Shiner	Notropis rebellus	C	C
Bluntnose Minnow	Pimephales notatus	A	A
Blacknose Dace	Rhinichthys atratus	S	
Longnose Dace	Rhinichthys cataractae	S	
Fallfish	Semotilus corporalis	A	A
White sucker	Catostomus commersonii	A	C
Northern Hog Sucker	Hypentelium nigricans	C	C
Golden Redhorse Sucker	Moxostoma erythrurum	C	C
Shorthead Redhorse	Moxostoma macrolepidotum	S	C
Yellow Bullhead	Amereiurus natalis	C	C
Channel Catfish	Ictalurus punctatus	A	A
Margined Madtom	Noturus insignis	C	C
Brown Trout	Salmo trutta		S
Banded Killifish	Fundulus diaphanus	C	C
Mosquitofish	Gambusia holbrooki		S
Rockbass	Ambliplites rupestris	A	A
Redbreast Sunfish	Lepomis auritus	A	A
Green Sunfish	Lepomis cyanellus	C	C
Pumpkinseed	Lepomis gibbosus	S	S
Bluegill	Lepomis macrochirus	C	C
Longear Sunfish	Lepomis megalotis	A	A
Smallmouth Bass	Micropterus dolomieu	A	A
Largemouth Bass	Micropterus salmoides	C	C
White Crappie	Pomoxis annularis		S
Black Crappie	Pomoxis nigromaculatus	S	
Greenside Darter	Etheostoma blennioides	A	A
Rainbow Darter	Etheostoma caeruleum	S	C
Tessellated Darter	Etheostoma olmstedi	A	A
Walleye	Sander vitreus		S
Total Species		**37**	**39**

5 - USGS FLOW DATA

Information on the Monocacy River's gauges and their applications to preparing for a safe and enjoyable floating trip on the Monocacy River.

Monocacy River at Bridgeport (BDGM2) USGS / 01639000 Monocacy River at Bridgeport, MD

Flood Descriptions:

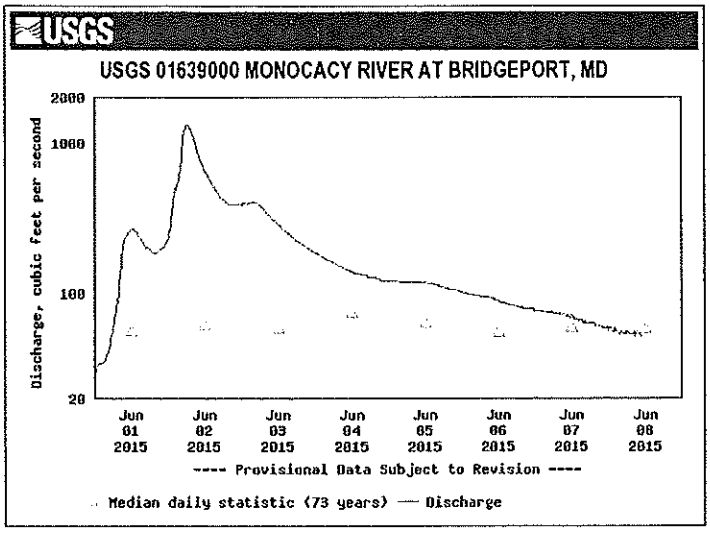
25 feet: Significant flooding is occurring on both sides of the river with homes and roads flooded.

23.5 feet: Water covers the Taneytown Pike bridge over the Monocacy. The road on each side will already be underwater.
21 feet: Water approaches homes on the Frederick County side near Bridgeport.

20 feet: Taneytown Pike begins to flood on both sides of the river.

16 feet: Flooding of fields and yards begins near Bridgeport.

13 feet: Baptist Road near Bridgeport begins to flood.



Historic Monocacy River Crests at Bridgeport

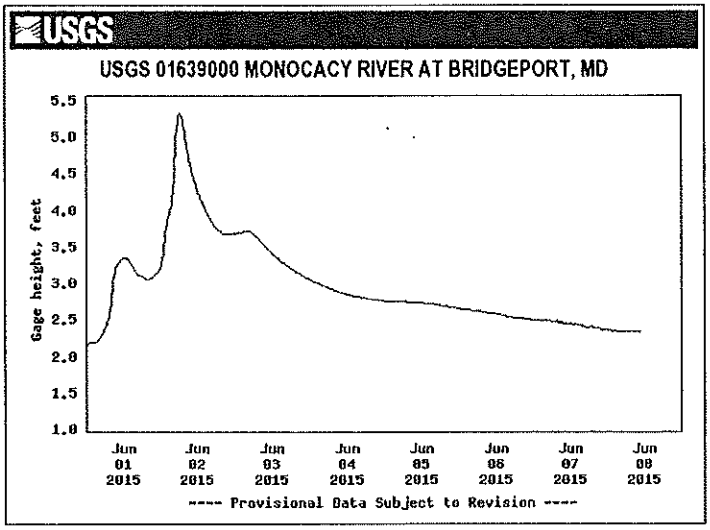
(1) 25.42 ft on 06/19/1996

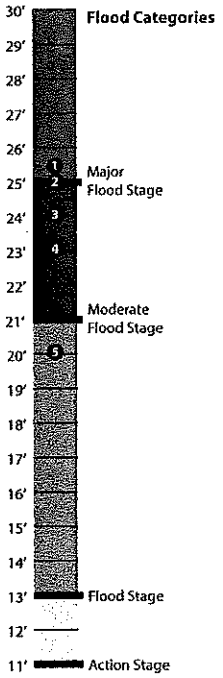
(2) 25.00 ft on 08/24/1933

(3) 24.05 ft on 06/22/1972

(4) 23.18 ft on 10/09/1976

(5) 20.53 ft on 05/21/1943





Monocacy River near Frederick at Interstate 70 (FDKM2)

USGS 01643000 MONOCACY RIVER AT JUG BRIDGE NEAR FREDERICK, MD

Historic Monocacy River Crests at I-70

(1) 35.90 ft on 06/23/1972 (91,600 cfs discharge, ICPRB Report 90-8)

(2) 30.80 ft on 09/26/1975

(3) 28.10 ft on 08/24/1933

(4) 25.38 ft on 10/10/1976

(5) 23.67 ft on 01/20/1996

Low River Water Records, I-70

0.50 ft on 09/11/1966 (19 cfs discharge, ICPRB Report 90-8)

Flood Descriptions

30: Water reaches the second floor of Gambrill Mill on the Monocacy National Battlefield.

24: Water approaches Urbana Pike near Monocacy National Battlefield.

21: Maryland Route 26 is flooded near the Monocacy River bridge.

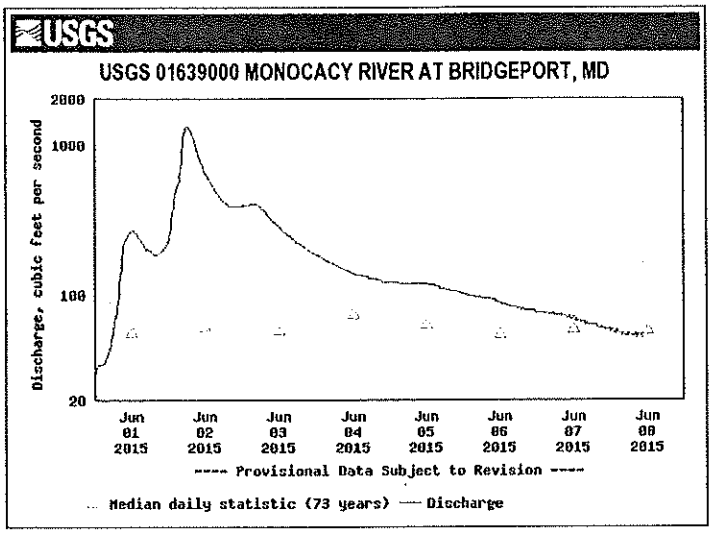
20: Water reach es Gambrill Mill on the Monocacy National Battlefield.

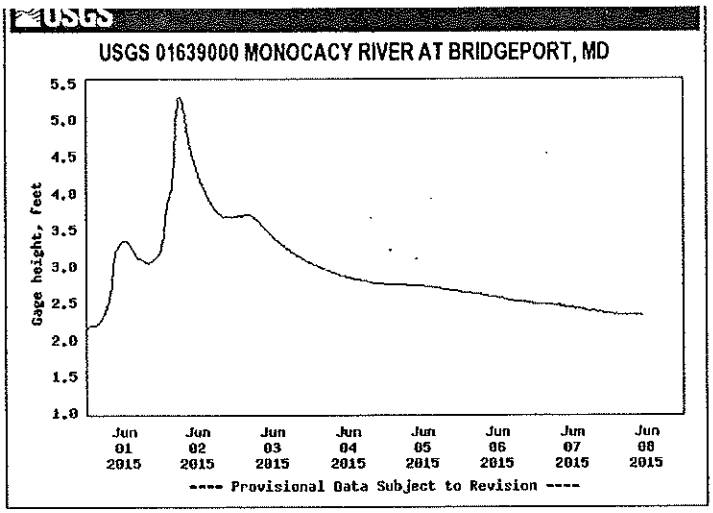
17: Significant lowland flooding is occurring along the river, with backwater flooding also occurring. Numerous roads are closed. Water is approaching the parking lot at Gambrill Mill on the Monocacy National Battlefield. Backwater flooding from Carroll Creek is likely approaching the underside of the bridge leading to the Frederick city wastewater treatment plant.

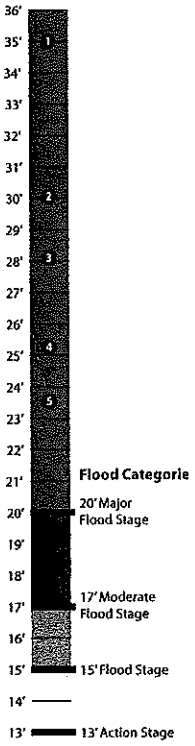
16: Much of Pinecliff Park and Rivermist Park in Frederick are flooded. Buckeystown Community Park is also flooded with water approaching the parking lot. Waters are also approaching the Frederick city wastewater treatment plant and the Ballenger Creek wastewater treatment plant. Significant backwater flooding is occurring. Several roads will be closed along the river and adjoining creeks.

15: Both banks of the river are flooded. Water begins to flood low-lying fields at Monocacy National Battlefield. Water reaches the access road of the Frederick city wastewater treatment plant. Backwater flooding is occurring on several area creeks, particularly Carroll Creek in Frederick.

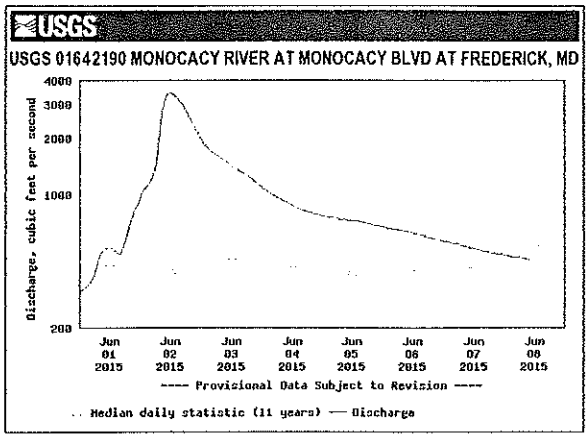
13: Water covers portions of Pinecliff Park in southeast Frederick. Water also approaches Rivermist Park in northeast Frederick.

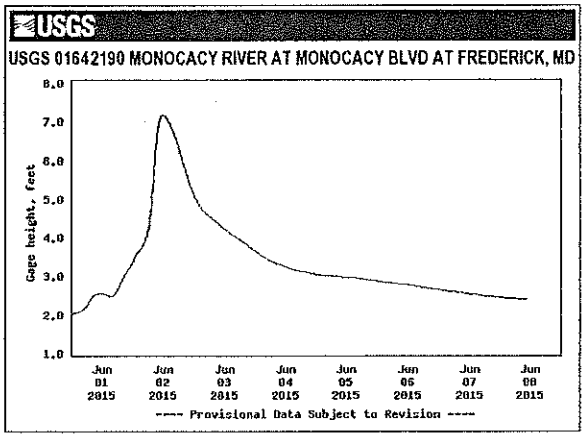


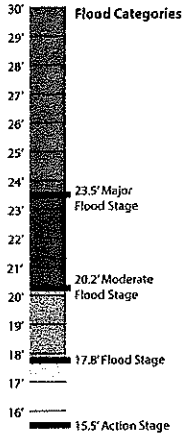




Monocacy River At Monocacy Blvd. in Frederick (FRMM2)
USGS 01642190 MONOCACY RIVER AT MONOCACY BLVD AT FREDERICK, MD







6 - ICPRB RIVER STUDIES

The following is a list of Monocacy River watershed studies from the Interstate Commission on the Potomac River Basin (ICPRB):

1951
Soils and Soil Erosion in the Monocacy River Basin

1987
A Conceptual Model of Sediment Transport and Delivery for the Monocacy River Sub-Basin of the Potomac River Basin / Stuart S. Schwartz

1989
Ground Water Data and Potentiometric Surface Maps of the Monocacy Watershed Model / Michael Focazio and Mark Sommerfield

1990
Monocacy River Watershed Modeling Project: Hydrometeorological Data Report / Elizabeth Casman

1993
Nutrient and Suspended Sediment Monitoring on the Upper Monocacy River 1990-1992 / Alan Blasenstein and Carlton Haywood

1997
Nutrient and Suspended Sediment Monitoring on the Upper Monocacy River 1990-1995 / Barry Gruessner and Carlton Haywood

2004
Annual and Seasonal Water Budgets for the Monocacy/Catoctin Drainage Area / Cherie Schultz, Deborah Tipton, and James Palmer

2007
Ground-water/Stream Flow Model of the Monocacy River Basin / James Palmer, Kristin Bergmann,and Cherie Schultz

2008
Seasonal Steady-State Ground Water/Stream Flow Model of the Upper Monocacy River Basin / Cherie Schultz and James Palmer

7 - FREDERICK COUNTY HISTORIC SITES

MONOCACY SCENIC RIVER PRELIMINARY LIST OF STANDING STRUCTURE HISTORIC SITES

Frederick County, Maryland

Adamstown Region:

National Register sites:

F-1-92	Monocacy Aqueduct, C& O Canal
18FR100	Monocacy Prehistoric Archaeological Site

Maryland Inventory of Historic Properties:

F-1-77	Michael's Mill and House
F-1-81	Bridge #100013, MD 85 at Monocacy River
F-1-128	James Doll House (may be demolished)
F-1-132	Furnace Ford Bridge, MD 28 at Monocacy River

Adamstown Region historic sites survey field notes (identified; no documentation or evaluation)

Field No.	
103	Greenfield Rd. (foundation & stone chimney stack)
104	1117 Greenfield Rd. (stone outbuilding and ruin of second building)
105	1155 Greenfield Rd. (house)

Frederick Region:

National Register sites:

F-3-42	Monocacy National Battlefield

Maryland Inventory of Historic Properties:

F-3-2	Devilbiss Bridge at Monocacy River (replaced)
F-3-54	MD 26 Bridge at Monocacy River
F-3-71	Devilbiss-Whitmore Farmstead
F-3-125	Michael Thomas Farmstead
F-3-128	Jug Bridge Tollhouse

Frederick Region historic sites field notes
(identified; no documentation or evaluation)

C-129	8230 Devilbiss Bridge Rd. (house)

City of Frederick:

18FR18	Rosenstock Village Archeological Site (NR eligible)

Thurmont Region:

National Register sites:

F-6-7	Fourpoints Bridge, Monocacy River
F-6-8	Bullfrog Rd. Bridge, Monocacy River
18FR81	Shoemaker Village Archeological Site

Maryland Inventory of Historic Properties:

F-6-9	Harney Rd. Bridge, Monocacy River
F-6-10	Mumma Ford Rd. Bridge, Monocacy River
F-6-11	Sixes Bridge, Monocacy River
F-6-23	Millers Bridge, Monocacy River
F-6-119	Bridge #10065, Monocacy River

Thurmont Region historic sites survey field notes: (identified; no documentation or evaluation)

C-50	at Rocky Ridge Rd. (farmstead)
C-55	12926 John Mehring Rd. (farmstead)
C-113	11801 Hunt Club Rd. (house)
E-3	10059 Ebby Rd. (demolition application 1997) (house)
E-19	inaccessible
E-22	14531 Sixes Bridge Rd. (farmstead)
E-23	14534 Sixes Bridge Rd. (farmstead)
E-29	at Sixes Rd. (cabin)

Urbana Region:

No National Register except C&O Canal National Historical Park

Maryland Inventory of Historic Properties:

F-7-28	St. Paul's AME Church, Della
F-7-117	Bridge, MD 355 at Monocacy River

Urbana Region historic sites survey field notes: (identified; no documentation or evaluation)

U-32	6740 Ed Sears Rd. (house)
U-37	6746 Ed Sears Rd. (house)

Walkersville Region:
National Register sites:

F-8-49	Legore Stone Arch Bridge

Maryland Inventory of Historic Properties:

F-8-41	Ceresville Stone Quarry
F-8-42	Ceresville Flour Mill
F-8-148	Railroad Bridge (Walkersville Southern Railroad) at Monocacy River

Walkersville Region historic sites survey field notes: (identified; no documentation or evaluation)

Wa-53	9400D Dublin Rd. (house)
Wa-124	10805A Haughs Church Rd. (farmstead)
Wa-126	10805C Haughs Church Rd. (agricultural outbuildings)
Wa-131	13006 Hiney Rd. (farmstead)
Wa-194	11919 Creagerstown Pike (farmstead)
Wa-220	10702 Links Rd. (house ruin and outbuilding)
Wa-225	10810 Dublin Rd. (house & barn foundation)

Frederick County Register sites in study area:
There are no listed County Register sites in the Monocacy River study area. However, in August 2013 the following site was determined by the Frederick County Historic Preservation Commission to be eligible for the County Register of Historic Places:

Determination of Eligibility – Trout Run (Richey Lodge)
12929 Catoctin Hollow Road, Thurmont, MD; Tax Map 25, P. 38
HPC Case # DOE 13-01

8 - MARYLAND'S WILD AND SCENIC RIVERS ACT

SUBTITLE 4. SCENIC AND WILD RIVERS

Md. NATURAL RESOURCES Code Ann. §8-401 , §8-402, §8-403

§ 8-401. Declaration of policy

Many of the rivers of Maryland or portions of them and their related adjacent land areas possess outstanding scenic, geologic, ecologic, historic, recreational, agricultural, fish, wildlife, cultural, and other similar values. The policy of the State is to preserve and protect the natural values of these rivers, enhance their water quality, and fulfill vital conservation purposes by wise use of resources within their surrounding environment. Development of a Scenic and Wild Rivers Program is desirable to fulfill these purposes.

§ 8–403.

(a) (1) (I) There is a Scenic and Wild Rivers Review Board.

(II) The Board consists of the Secretaries of Natural Resources, Agriculture, and the Environment and the Director of Planning and a member of the Garrett County Commissioners, who shall be a voting member of the Board only on matters pertaining to the wild portion of the Youghiogheny River.

(2) The members of the Board shall select the chairperson.

(3) A member of the Board:

(i) May not receive any compensation for the member's services; but

(ii) Shall be reimbursed for necessary travel expenses and disbursements made in order to attend any meeting or perform any other official duty.

(b) In addition to the duties set forth elsewhere in this subtitle, the Scenic and Wild Rivers Review Board shall:

(1) Review:

(i) Any inventory, study, plan, and regulation that is prepared under this subtitle; and

(ii) The recommendations on the inventory, study, plan, and regulation of the Secretary, any local governing body, or any local advisory board;

(2) Meet regularly; and

(3) Appoint, with the advice and consent of the appropriate local governing body, a local scenic and wild river advisory board for each river that is included in the Scenic and Wild Rivers Program.

(c) (1) Each local scenic and wild river advisory board consists of at least [7] SEVEN members, except for the Youghiogheny local Scenic and Wild River Advisory Board that consists of at least [8] EIGHT members.

(2) Each member of a local scenic and wild river advisory board shall reside in the county through which the scenic and wild river flows.

(3) The Scenic and Wild Rivers Review Board shall select the members of each local advisory board as follows:

(i) At least [2] TWO members shall own land contiguous to the scenic or wild river, except for the Youghiogheny River where at least [3] THREE members shall own land contiguous to that portion of the river designated by § 8–408(a) of this subtitle as a wild river;

(ii) At least [2] TWO members who own land that is not contiguous to the scenic or wild river;

(iii) [1] ONE member shall represent the local governing body; and

(iv) [2] TWO members from the county soil conservation district.

(d) If a scenic or wild river flows through more than [1] ONE county, the local advisory board shall consist of no more than the following members:

(1) [2] TWO residents of each county through which the scenic or wild river flows who own land contiguous to the scenic or wild river;

(2) [2] TWO residents of each county through which the scenic or wild river flows who do not own land contiguous to the scenic or wild river;

(3) [2] TWO representatives of the local governing body of each county through which the scenic or wild river flows; and

(4) [1] ONE representative of each soil conservation district through which the scenic or wild river flows.

(e) Each local scenic and wild river advisory board shall:

(1) Review any inventory, study, plan, and regulation that is proposed under this subtitle and is applicable to any river in its jurisdiction;

(2) Make recommendations on the inventory, study, plan, and regulation to its local governing body and to the Scenic and Wild Rivers Review Board;

(3) Select its own chairperson; and

(4) Adopt its own administrative regulations for the operation of the local advisory board.

(f) (1) Each member of a local advisory board may not:

(i) Receive compensation for service; or

(ii) Be reimbursed for expenses incurred in travel or for attending meetings or performing any official duty.

(2) The Secretary shall schedule meetings for each local advisory board. However, in the event of emergencies, the chairperson of a local advisory board may schedule meetings for the local advisory board.

(g) (1) [Upon] ON completion of an approved management plan, the local governing body may establish a scenic river advisory board for each designated scenic or wild river within its jurisdiction.

(2) Each board, as constituted by the local authority, may recommend policies, laws, and regulations in furtherance of the aims of this subtitle to the appropriate local governing body.

(3) (I) [If] EXCEPT AS PROVIDED IN SUBPARAGRAPH (II) OF THIS PARAGRAPH, IF a scenic or wild river flows through more than [1] ONE county, the scenic river advisory board may consist of an equal number of members from

each county.

(II) IF A SCENIC OR WILD RIVER FLOWS THROUGH CARROLL COUNTY AND ONE OR MORE OTHER COUNTIES, THE SCENIC RIVER ADVISORY BOARD SHALL CONSIST OF THE FOLLOWING MEMBERS:

1. TWO RESIDENTS OF EACH COUNTY THROUGH WHICH THE SCENIC OR WILD RIVER FLOWS WHO OWN LAND CONTIGUOUS TO THE SCENIC OR WILD RIVER;

2. TWO RESIDENTS OF EACH COUNTY THROUGH WHICH THE SCENIC OR WILD RIVER FLOWS WHO DO NOT OWN LAND CONTIGUOUS TO THE SCENIC OR WILD RIVER;

3. SUBJECT TO SUBPARAGRAPH (III) OF THIS PARAGRAPH, TWO REPRESENTATIVES OF THE LOCAL GOVERNING BODY OF EACH COUNTY THROUGH WHICH THE SCENIC OR WILD RIVER FLOWS; AND

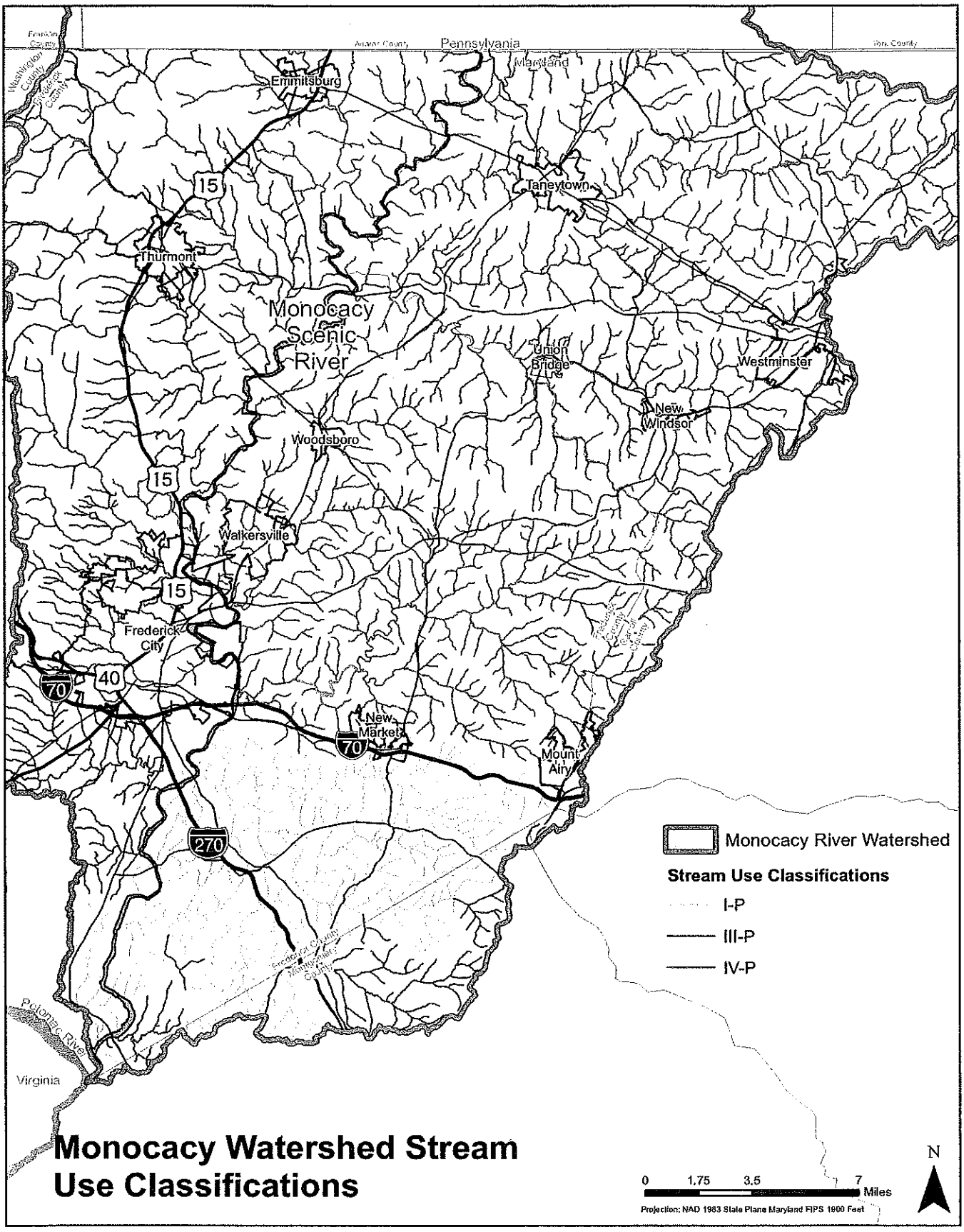
4. ONE REPRESENTATIVE OF AN ORGANIZATION IN THE COUNTY WITH EXPERTISE IN AGRICULTURE, SUCH AS THE LOCAL FARM BUREAU, GRANGE, OR SOIL CONSERVATION DISTRICT.

(III) THE TWO REPRESENTATIVES OF THE LOCAL GOVERNING BODY SHALL BE NONVOTING MEMBERS OF THE SCENIC RIVER ADVISORY BOARD.

SECTION 2. AND BE IT FURTHER ENACTED, That this Act shall take effect October 1, 2018.

Approved by the Governor, April 24, 2018.

9 - MARYLAND'S DESIGNATED WATER USES



Maryland's Designated Uses (COMAR 26.08.02)

- Use I: Water contact recreation and protection of nontidal water water aquatic life
- Use II: Support of estuarine and marine aquatic life and shellfish harvesting (not all subcategories apply to each tidal water segment)
    - Shellfish harvesting and subcategories unique to Chesapeake Bay only
- Use III: Nontidal cold water – usually considered natural trout waters
- Use IV: Recreational trout waters – water are stocked with trout

If the letter "P" follows the use class listing, that particular stream has been designated as a public water supply. The designated use and applicable use classes are found in the following table:

	Use Classes							
Designated Uses	**I**	**I-P**	**II**	**II-P**	**III**	**III-P**	**IV**	**IV-P**
Growth and Propagation of fish (not trout), other aquatic life and wildlife	✓	✓	✓	✓	✓	✓	✓	✓
Water Contact Sports	✓	✓	✓	✓	✓	✓	✓	✓
Leisure activities involving direct contact with surface water	✓	✓	✓	✓	✓	✓	✓	✓
Fishing	✓	✓	✓	✓	✓	✓	✓	✓
Agricultural Water Supply	✓	✓	✓	✓	✓	✓	✓	✓
Industrial Water Supply	✓	✓	✓	✓	✓	✓	✓	✓
Propagation and Harvesting of Shellfish			✓	✓				
Seasonal Migratory Fish Spawning and Nursery Use			✓	✓				
Seasonal Shallow-Water Submerged Aquatic Vegetation Use			✓	✓				
Open-Water Fish and Shellfish Use			✓	✓				
Seasonal Deep-Water Fish and Shellfish Use			✓	✓				
Seasonal Deep-Channel Refuge Use			✓	✓				
Growth and Propagation of Trout					✓	✓		
Capable of Supporting Adult Trout for a Put and Take Fishery							✓	✓
Public Water Supply		✓		✓		✓		✓

Sub-Basin 02-14-03: Middle Potomac River Area.

Designated Use Class and Waterbody	Latitude	Longitude	Limits
(1) Class I-P: Potomac River and all tributaries except those designated below as Class III-P or Class IV-P	39.221736	-77.456451	From Frederick/Montgomery County line to confluence with Shenandoah River
(2) Class II: None.			
(3) Class III: None.			
(4) Class III-P:			
(a) Tuscarora Creek and all tributaries	39.458359	-77.375099	
(b) Carroll Creek and all tributaries	39.423513	-77.429438	Upstream of U.S. Route 15
(c) Rocky Fountain Run and all tributaries	39.332070	-77.422527	

(d) Fishing Creek and all tributaries	39.505696	-77.391445	
(e) Hunting Creek and all tributaries	39.550482	-77.358179	
(f) Owens Creek and all tributaries	39.579028	-77.332576	
(g) Friends Creek and all tributaries	39.719868	-77.389272	
(h) Catoctin Creek and all tributaries	39.450300	-77.562603	Upstream of Alternate U.S. Route 40
(i) Little Bennett Creek and all tributaries	39.279411	-77.314709	Upstream of MD Rt. 355
(j) Furnace Branch and all tributaries	39.243999	-77.439955	
(k) Ballenger Creek and all tributaries	39.362694	-77.410124	
(l) Bear Branch and all tributaries	39.292638	-77.405135	From confluence with Bennett Creek upstream
(m) Middle Creek and all tributaries	39.448829	-77.603343	Upstream of the confluence with an unnamed trib south of Geaslin Drive
(n) Unnamed tributary to Talbot Branch and all tributaries to this unnamed tributary	39.455887	-77.160651	Stream flows in southerly direction. Mouth of stream joins Talbot Branch near intersection of Black Ankle Road and Talbot Run Road
(o) Unnamed tributary to Talbot Branch and all tributaries to this unnamed tributary	39.454004	-77.154174	Stream flows in northwesterly direction. Mouth of stream joins Talbot Branch 500 meters east of the intersection of Black Ankle Road and Talbot Run Road
(p) Unnamed tributary to Big Pipe Creek and all tributaries	39.675821	-76.941553	Upstream from confluence with another unnamed tributary just south of Wine Road
(q) Bennett Creek and all tributaries	39.310961	-77.231394	From a point, 700 yards to the east of the intersection of Moxley and Clarksburg Road, upstream
(r) Unnamed tributary to Bennett Creek	39.303758	-77.286898	Near intersection of Prices Distillery Road and Haines Road
(5) Class IV: None.			
(6) Class IV-P:			
(a) Monocacy River and tributaries except those designated above as Class III-P	39.398435	-77.366868	Upstream of U.S. Rt. 40
(b) Catoctin Creek	39.309777	-77.567051	Mainstem only, from mouth upstream to Alternate U.S. Rt. 40
	39.450300	-77.562603	
(c) Israel Creek and all tributaries	39.327756	-77.682559	

Growing Crops in the Buffer

Farming in buffers will look and feel different than a typical farm field or forest. Because the crops are close to the river, your farming practices have to take the river into account. Many of these guidelines are requirements for all Vermont farmers, noted as State Regulations. If you work with a conservation organization, they may require these or similar practices, depending on your agreement or contract.

Designing and Managing Your Buffer

- **Let the river meander.**
- **Follow the USDA's three-zone buffer design.**
- **Allow your buffer's boundaries to "float," or move when the river changes.**
- **Do not protect plantings from the river's natural movement with rip rap or other methods.**
- **The unmanaged strip along the waterway must be at least 10' wide (25' for Medium and Large Farm Operations) (State Regulation).**
- **Leave banks in their natural state (State Regulation).**
- **Limit trampling and equipment damage on banks (State Regulation).**
- **Do not develop roads within the buffer.**
- **If trees or shrubs are already growing along your river, leave them in place, and plant crops in openings.**

Growing Crops in the Buffer

- **Grow a diversity of perennial crops.**
- **If you amend soils, do so based on soil tests (State Regulation).**
- **Do not apply manure within the buffer (State Regulation).**
- **Limit application of chemicals to crops.**
- **Limit equipment use for planting, maintenance, and harvest.**

Dealing with Risk in Floodplains

Floodplains offer rich soils and flat land – but they also put farmers at risk to flooding. Major storms, like Irene and Sandy, are becoming more frequent and more intense, so farmers are adapting. Growing a riparian buffer is one way to adapt, because buffers absorb floodwaters and hold soil in place.

- Allow the river to meander and flood. Do not protect crops from flooding or secure the riverbanks using rip rap, channelization, or other means.
- Let buffers "float" – when the river moves, the buffer moves, too. Areas that are outside of the buffer initially may eventually be located within the buffer.
- Know that the crops you plant in the buffer may be lost to flooding.
- Plant crops in the most stable parts of your buffer. Do not plant where the river is actively eroding.
- Choose crops that are adapted to flooding: deep rooted, sprouting perennial crops
- Plan to invest some energy and money into maintaining the buffer. Mow or mulch plantings to give them a good start. Replant lost trees. Protect plantings from browse. Inspect the buffer annually and after storms.

Thinking Critically About the Economics

Should every buffer be agriculturally productive?
Absolutely not. This type of buffer management is an option when the river is stable and you want to keep the land in agricultural production. Other buffers are too risky to plant in crops.

Are buffer crops really economically viable? At what scale?
We're still learning. Farmers in other parts of the country are growing crops in their buffers at backyard and commercial scales. We'll know more about yields, costs, and markets for buffer crops in Vermont as more pioneering farmers plant in their buffers (see last question). We encourage you to talk with us, other farmers who are growing crops in their buffers, and with your Extension agent or NOFA-VT technical assistance advisor. Together, we can provide resources about what crops make sense along your floodplains as well as the economics of these crops.

Can agriculturally productive buffers qualify for conservation funding?
Sometimes. Energy is building around the idea of agriculturally productive buffers, and several local groups are funding buffers that include crops (see next question). Federal programs (including NRCS) do not typically pay for planting crops in buffers, or allow for harvest in riparian areas.

Is anyone planting agriculturally productive buffers in Vermont? Who's funding these plantings?
Yes. Several farmers have planted agriculturally productive buffers, and nonprofits are helping fund their work. The Friends of the Mad River helped plant elderberry for a commercial grower near Waitsfield. Trees for Streams helped plant Zone 1 of a buffer at a tree nursery near Johnson. Because they paid for planting the native buffer, the farmer could afford to plant crop trees in Zone 2, including hazelnuts (nuts), black locust (timber), plums (fruit), apples (fruit), and more. The White River Partnership helped farmers plant homestead-scale fruits and berries in Royalton. The Vermont River Conservancy is helping farmers plant locust (fence posts), high bush cranberries (fruit), and late-cut hay (forage) in Cambridgeport.

Resources for Learning More

- **Establishing and Managing Riparian Forest Buffers** (University of Missouri Center for Agroforestry) provides a comprehensive guide to planning agriculturally productive buffers.
- **Riparian Forest Buffer Design, Establishment, and Maintenance** (Maryland Cooperative Extension, 1998) explains the three-zone concept and covers planning and planting options.

LAKE CHAMPLAIN Sea Grant

GREEN MOUNTAIN COFFEE

This handout is a product of Liz Brownlee's graduate project at the University of Vermont. Her work was generously funded by the Green Mountain Coffee Roasters and the Lake Champlain Sea Grant, and builds on the good work of many organizations.

Contact Liz for more information about agriculturally productive buffers:
liz.brownlee@yahoo.com

2013

Related Posts:

- **Summer 2013 Quarterly**
  -

ELDERBERRY AND BEYOND: NEW OPTIONS FOR RIVER LANDS IN THE NORTHEAST

Riparian buffer plantings can reap rewards for nature *and* business.

By Liz Brownlee and Connor Stedman

Stan Ward springs into his greenhouse full of excitement, eager to show off elderberry cuttings. He's growing elderberry, Echinacea, and other perennial medicinals on his upland farm in central Vermont, but these elderberries are bound for lower ground. This year, he's planting them into one of three riparian buffer plantings along the Mad River, continuing a project that began in 2012. The elderberry will absorb floodwaters, keep farm field runoff out of the river, and reduce erosion. And, they will generate income as an agricultural enterprise.

The river's edge can be tense territory, where conservation and agriculture seem permanently in conflict. Farmers, working with razor-thin profit margins, want the rich soils in production. Conservationists want floodplains to grow native ecosystems that absorb floodwaters, remediate pollution, and provide wildlife habitat. At the same time, the river's edge can also be a place of great collaboration. Stan's plantings are innovative, in part, because he's establishing them in partnership with his local watershed group and the local conservation district.

Elderberry cuttings at Stan Ward's Vermont farm. Photo by Liz Brownlee.

Planting elderberry in the buffer creates what Stan calls a "win-win-win" for watershed health, wildlife conservation, and the local farm economy. Stan isn't the only one interested. A small but growing number of farmers, conservationists, and land managers in Vermont are beginning to add productive buffers to their toolboxes. Farmers are planting on commercial and homestead scales across the state. By directly integrating agriculture and conservation, these working buffers could help farms and watersheds alike adapt to increased flooding and the new climate "normal" of the 21st century.

Rivers, Flooding, and Tropical Storm Irene

River channels support an extraordinary abundance of life. Water continually shifts and meanders, carving banks and revealing new land. On any summer evening turtles bask on gravel bars while swallows and kingfishers nest in steep exposed banks. These habitat features are found nowhere else in the wider landscape, and are constantly changing as the river moves. When rivers flood from snowmelt or storms, they deposit rich silt and sand in their floodplains, supporting riparian forests and riverbank meadows. These in turn provide food and shelter for countless wildlife species.

For farmers, rivers are a blessing and curse. They provide extremely fertile and easily plowed agricultural soils, but the threat of damaging floods is ever-¬present and increasing with climate change. In late August 2011, Tropical Storm Irene dumped 4-8 inches of rain throughout Vermont in less than 24 hours. Flooding eroded entire fields, carried away barns, livestock, and greenhouses, and buried crops in sand and gravel. Almost 15,000 acres of Vermont farmland sustained damage; farmers in the state lost at least $20 million in one day.

Intact riparian landscapes can mitigate the impacts of flooding. Flooding along the Otter Creek from Irene impacted 92 farmers in the vicinity of Rutland, Vermont. Thirty miles downstream, in Middlebury, only 41 farmers reported damage. While crop damage was similar in both places, farmland impacts were not: the flood damaged only 60 acres of land in the Middlebury area, compared to over 4,000 acres surrounding Rutland. The difference lies, in part, in a large system of intact swamps, wetlands, and floodplain buffers along the Otter Creek between Rutland and Middlebury. These ecosystems

slowed and absorbed the floodwaters, shielding many Middlebury farms from the worst of the storm's effects.

The physical features of riverbeds continually change with cycles of flooding. Photo by Connor Stedman.

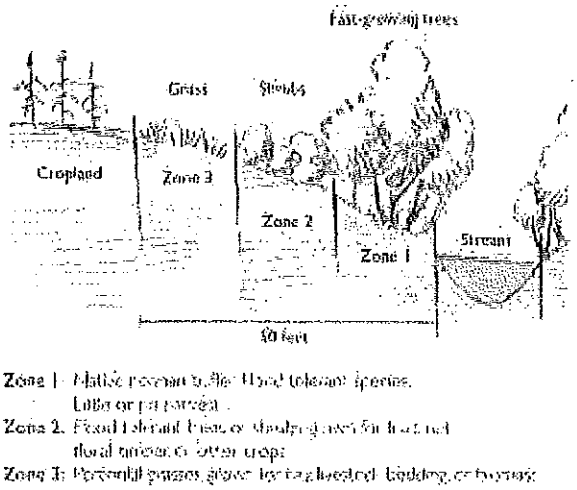
Riparian Buffers in the Working Landscape

Riparian buffers retain strips of natural vegetation along riverbanks, generally 20 to 50 feet wide. They mimic larger riparian ecosystems, like the ones that protected Middlebury during Irene, and allow natural river processes and communities of life adapted to floodplains to continue within agricultural landscapes. Buffers improve water quality, in particular, by acting as giant filters. High levels of nitrogen and phosphorus in agricultural runoff can disrupt river food webs and cause algae blooms. The trees, shrubs, and perennial herbs and grasses in riparian buffers slow overland water movement, allowing sediments and nutrients to deposit into the soil and keeping pollutants out of waterways. The root systems of these riparian plants, adapted to frequent flooding, rapidly absorb excess nutrients and make use of what would otherwise be waste. Buffers are essential for swimming, migratory fish breeding, and other river functions that depend on water quality.

A host of government and local programs encourage farmers to plant riparian buffers, but many farmers choose not to participate. Some farmers simply can't afford to take any land out of production. Others don't want to see productive land sit "idle". Often, farmers simply don't want to sign on the government's dotted line. They want to manage their land independently, and state and federal buffer planting programs often require contracts and include usage restrictions. Local programs may only require a handshake agreement, but even in those cases planting the river's edge with trees restricts farmers' options. Some dislike the aesthetic of a brambly forest hiding the river from view. For these reasons and many others, farmers often avoid or flatly reject planting riparian buffers on their land.

But a new idea is showing up on Vermont riverbanks, a system that brings farmers back to the table. Growing agriculturally productive buffers is a strategy that can make sense for both farmers and conservationists.

Agriculturally Productive Buffers: An Emerging Option



Agriculturally productive buffers generate ecosystem services and produce perennial crops. Illustration by Kelly Finan.

Agriculturally productive buffers (APBs) are a form of agroforestry, integrating forest management with agricultural production. They incorporate the essential elements of traditional riparian buffers, but also include perennial crop systems. Typically, the portion of the APB nearest to the riverbank, Zone 1 (see diagram), is restored as natural riparian forest. Zone 2 is an alley of flood tolerant shrub or small tree crops, such as elderberries, hazelnuts, or fencepost black locusts. Finally, the field-side Zone 3 grows late-cut hay, keeping perennial grass cover during the spring and late fall flooding season. Productive buffers provide flood¬ resistant agricultural enterprises while incorporating natural river processes into farmland: flood tolerance, deeply taprooted trees, year-round plant cover, and room for river meanders.

Productive Buffers: Economics and Funding Sources

APBs can be funded through multiple sources, including crop revenue and certain riparian buffer grant programs. However, it is important to note that riparian buffers funded through CREP (the FSA's Conservation Reserve Enhancement Program) cannot include any harvesting or sale of agricultural or forest products. Some state and local funding sources may offer more flexibility. Upcoming trials in Vermont will evaluate the economics of a range of APB plantings, at commercial and smaller scales. These trials will help small farmers make informed decisions about APBs. If you'd like to learn more about APBs or current trial plantings, contact Liz Brownlee at ejbrownl@uvm.edu.

Agriculturally productive buffers may overcome the obstacles preventing farmers from participating in the current buffer planting programs. These buffers keep farmland in production and help farmers take care of both their land and their bottom line. There are no government contracts and no paperwork, though some groups are working to establish local funding sources and best management practices. It's also clear that many details of productive buffer systems will need to be learned over time. In a changing climate and economy, this flexibility and adaptation may well be critical.

Collaborating is proving key to the success of productive buffer projects. Local nonprofits are helping Vermont farmers with logistics, and some are finding funding for planting strips of native floodplain trees within APBs. These collaborations are allowing farmers to grow much needed riparian buffers,

increase flood resilience, improve water quality, create wildlife habitat, and grow crops. Crops currently planted as components of productive buffers in Vermont include nuts (hazelnuts, black walnuts) fruit (pears, currants, highbush cranberries), fenceposts (black locust), forage (late cut hay), and, of course, Stan Ward's elderberries.

The Friends of the Mad River, a local conservation organization, partnered with Stan to establish his elderberry buffers. Caitrin Noel, FMR's Executive Director, is cautiously optimistic about the potential for productive riparian buffers to become more widely used on Vermont farms. "Working with Stan to create working buffers definitely requires more flexibility." She says that APBs can help reconcile ecosystem health and community values. "It makes buffers more palatable to farmers who hesitate to take the land out of production entirely. If managed properly, I think the model could represent the best of both worlds."

Liz Brownlee helps Vermont farmers and conservationists partner to care for their rivers. She can be reached at ejbrownl@uvm.edu. Connor Stedman is an agroforestry specialist based in Guilford, Vermont. He can be

Info

Working Trees

Why add edible and floral plants to riparian forest buffers?

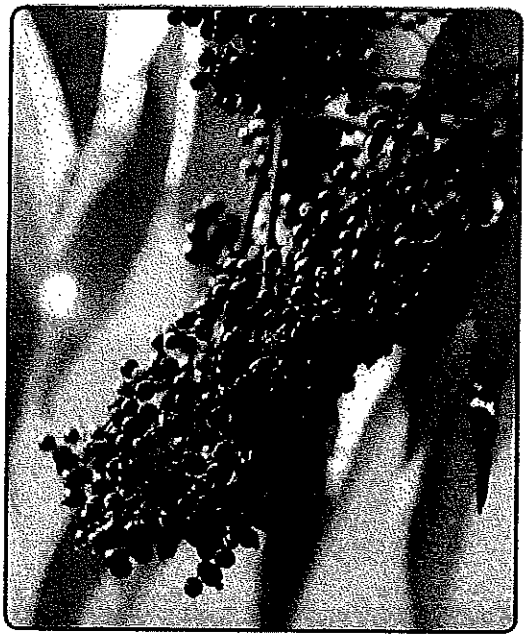
Multifunctional riparian forest buffers (MRFBs) offer the opportunity to produce perennial crops of native fruits and nuts, as well as floral trees and shrubs.

These products can be harvested and sold at retail or wholesale markets, and used at home. This information sheet provides examples of how these plants can be added to riparian forest buffers in the Appalachian region.

As their name implies, MRFBs have a wide range of functions. They filter runoff and keep stream banks stable, helping to improve water quality by reducing the amount of nutrients and sediment that flows into waterways. They also shade the water, providing habitat for some cold water-dependent fish species. MRFBs provide habitat for wildlife, including pollinators, and can act as wildlife corridors, providing cover and food sources. Providing habitat for beneficial insects may reduce the need for pesticides, which may have an additional environmental benefit.

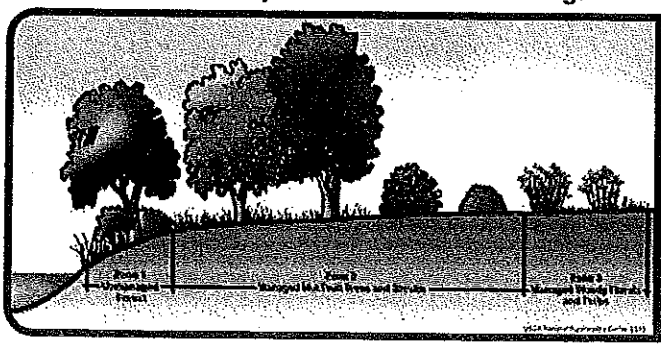
Multifunctional buffers also have social benefits. By protecting water quality, MRFBs contribute to safe, clean drinking water for all that live downstream. Increased wildlife habitat means more opportunities for people to enjoy the outdoors through hunting, fishing, bird watching, and water sports.

Riparian buffers planted with a rich diversity of native fruits, nuts, and florals offer the grower a special connection with local tradition, culture, and folklore. Pawpaws, for example, are rarely found on supermarket shelves, but have long been a delicacy. Older fans of pawpaws may buy them at farmers markets to savor a taste from their youth, while those new to pawpaws might further their appreciation of the land where they grow wild. American persimmon, when tasted at peak ripeness in the late fall or early winter, has an unparalleled flavor and is a traditional holiday treat. Serviceberry, also known as sarvis, Saskatoon, or juneberry, has an underappreciated blueberry-like fruit, and everyone loves the clouds of white flowers born in early spring. Native fruits, nuts, and florals are a part of what makes a region unique. Each region has its own set of native fruits, nuts, and florals with potential to be incorporated into MRFBs.



Elderberries can be a component of multifunctional riparian forest buffers.
(Photo credit: Katie Commender/Virginia Tech)

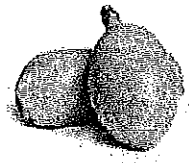
Multi Functional Riparian Forest Buffer Design



Zones 2 and 3 can be planted with different species and at expanded widths to incorporate perennial crops of fruits, nuts, and floral trees and shrubs.

Edibles and florals harvested from multifunctional riparian forest buffers*

Pawpaw



Hidden Beings

Market Opportunities

With a tropical flavor, custard texture and high nutrient content, America's forgotten fruit can be eaten fresh or made into desserts.

Average Prices

Fresh fruit: $2/lb wholesale
$3+/lb retail
Frozen pulp: $6/lb retail
Jam: $6/oz jar retail

Persimmon

ASD Emily Lachiet

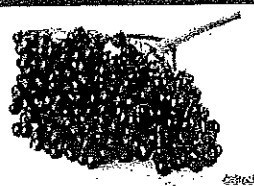
Market Opportunities

The "Fruit of the Gods," sweet persimmon can be sold fresh or made into pudding, jam, dried fruit and even beer.

Average Prices

Fresh fruit: $2.75/lb retail
Frozen pulp: $8+/lb retail
Dried fruit: $11+/lb retail

Elderberry



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Market Opportunities

Coined "Nature's Medicine Chest" for its immune boosting properties, elderberries can be made into syrup, cough drops, juice, wine, jam and food coloring.

Average Prices

Juice: $15-$17/11oz jar
Syrup: $18/4oz jar retail
Wine: $10-$13/bottle retail
Cough drops: $2.50/15 retail

Hazelnut

©iStockphoto/Nikola

Market Opportunities

A great source of fiber and 'good' fats, hazelnuts can be sold in shell or shelled and made into flours, candles, butters and oils.

Average Prices

In shell: $3/lb wholesale
Shelled: $6/8oz retail
Oils: $8/8oz jar retail

Woody Florals

©iStockphoto/Dalan

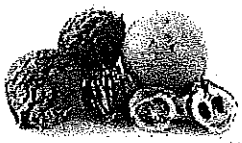
Market Opportunities

Woody florals, such as pussy willow and red and yellow twig dogwood, can be coppiced every 2-3 years and sold to the floral industry or used in crafts.

Average Prices

Cuttings: $0.37-0.45/stem retail
Wreaths: $45+ ea retail

Black Walnut



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Market Opportunities

This multi-use tree produces valuable timber and heart-healthy nuts sold in shell or shelled.

Average Prices

In shell: $9.25/lb retail
Shelled: $12/lb retail

*Prices can vary considerably by season and local markets.

APPALACHIAN sustainable DEVELOPMENT

Forest Resources & Environmental Conservation at Virginia Tech

USDA National Agroforestry Center

Contact: USDA National Agroforestry Center: 402.437.5178 ext. 4011; fax 402.437.5712; 1945 N. 38th St., Lincoln, Nebraska 68583-0822. nac.unl.edu/

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DCNR CONCEPT for MULTIFUNCTIONAL RIPARIAN FOREST BUFFERS

Purpose: To help Pennsylvania meet the goal of installing an additional 95,000 acres of forested buffers by 2025.

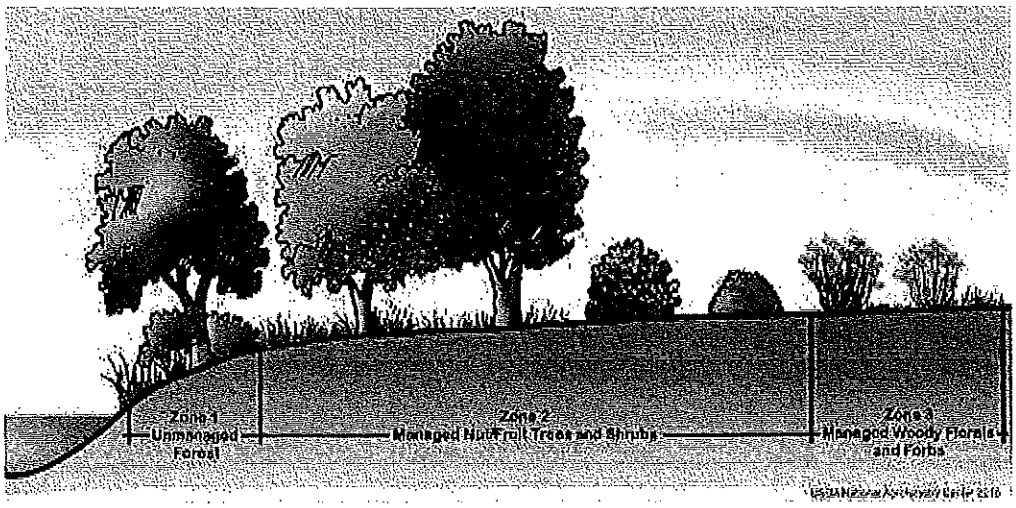
Definition: A riparian forest buffer that provides opportunities for harvesting products such as nuts, berries, woody florals, forbs, and potentially woody biomass. Inputs such as fertilizer or manure would not be permitted, and harvesting would not be permitted in the first 15 feet of the buffer from the edge of the streambank. An overall minimum width of 35 feet is recommended.

Rationale: Pennsylvania has led the nation for many years in establishing forested riparian buffers, but recently, enrollments have declined. Without additional tools beyond what is currently available, Pennsylvania is unlikely to meet its goal. This program offers an additional way to meet the goal.

Adding greater flexibility in landowner eligibility, buffer designs, allowable plant materials, and other elements, without compromising water quality, will reinvigorate interest in riparian buffers and accelerate participation across the Bay watershed. Allowing landowners to produce an income from woody plants that meet DCNR's criteria (see below) provides additional incentives for landowners to establish buffers, maintain them, and remain in the program long-term. No rental payments will be provided, but landowners will be able to keep some or all of the income derived from their buffer plants.

Criteria: Because of the need for greater program flexibility, we are providing limited guidance to ensure that buffers increase water quality and other critical benefits while remaining attractive to more landowners. DCNR recommends a minimum overall buffer with of at least 35 feet (Zone 1 + Zone 2 as described below.)

Planting Zones:



Buffer zoning from USDA National Agroforestry Center (2015)

Zone 1– from stream edge to 15 feet, native riparian forested trees and shrubs, no harvesting zone.

Zone 2 – from edge of Zone 1 out another 20 feet to 35 feet or more, fruit and nut trees and shrubs, non-mechanical harvest allowed.

Zone 3 – from edge of Zone 2 out another 50 to 100+ feet, woody florals and forbs, including biomass crops. Mechanical harvest allowed.

Planting establishment and maintenance:

Zone 1– Herbicide use allowed at site prep and twice annually for maintenance. Spacing and density will vary by species, by site characteristics, and by landowner and third-party installer. Acceptable planting methods include containerized stock, bare-root seedlings, direct seeding, or other approved methods. Site prep and annual maintenance may include use of approved herbicides for riparian areas, but should be minimized.

Zone 2 - Herbicide use allowed at site prep and twice annually for maintenance. Spacing and density will vary by species, by site characteristics, and by landowner and third-party installer. Containerized stock are preferable to generate income production earlier. Buffer widths may vary based on hydrology, soil type and other conditions.

Zone 3 - Herbicide use allowed at site prep and twice annually for maintenance. Spacing and density will vary by species, site characteristics, and landowner and third-party installer. Mechanized planting and harvesting permitted. Live-stakes, in addition to bare-root, direct-seed, and containerized stock, are permitted. Buffer widths may vary based on hydrology, soil type and other conditions.

Monitoring: Monitoring will be established at representative projects to measure nutrient uptake and water quality changes. Landowner observations of buffer wildlife use will also be collected as provided.

Example Multifunctional Buffer Plants and Products:

Zone 1 – see DEP forested riparian buffer guidance document (2010) for approved plant species.

Zone 2 – serviceberry, black walnut, raspberry, elderberry, chokeberry, highbush blueberry, American hazelnut, crabapple, pawpaw, persimmon.

Zone 3 – woody florals: dogwoods, pussy willow, quince, witch hazel, curly willow, hydrangea; chestnut, black locust.

11 - MONOCACY RIVER RESOURCE AREA MAP SECTIONS